COMPARATIVE EVALUATION OF EFFECTIVENESS OF E-C CLAMP VERSUS V-E TECHNIQUE IN PATIENTS WITH PREDICTED DIFFICULT MASK VENTILATION

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BY

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Dedicated

to

My

Family &

teachers

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ABSTRACT

Background: The skill of bag mask ventilation (BMV) remains pivotal during airway management for maintenance of oxygenation in apnoeic unconscious patients. Two-handed BMV techniques viz., the traditional E-C and V-E have been proven to be superior to one-handed techniques in optimizing BMV in difficult mask ventilation (DMV) scenarios. We aimed to compare the effectiveness of these two techniques of BMV in adult patients with predicted DMV.

Methods: Four hundred ASA I-III adult patients with predictors of DMV received BMV after induction of anaesthesia using E-C clamp and V-E techniques in a randomized cross-over manner. Ventilator was set to VCV mode delivering tidal volume of 7 ml/kg, respiratory rate of 10 breaths per minute, and no PEEP. The primary outcome was exhaled tidal volume (Vte) and secondary outcomes analysed included air-leak, peak inspiratory pressure (PIP), end-tidal carbon dioxide ($EtCO_2$), minute ventilation (MV), plateau pressure and SpO_2.

Results: Two-handed V-E technique generated significantly higher mean Vte of 377.83 ± 58.43 ml as compared to two-handed E-C technique (303.26 ± 103.34 ml). The air-leak was found to be significantly more with E-C technique (131.05 ml ± 100.95 ml) as compared to V-E technique (59.08 ± 49.62 ml). Higher $EtCO_2$, MV with concomitant lower airway pressures were observed with V-E technique. Failure rate of BMV was significantly higher with E-C technique (19%) as compared to V-E technique (1%) ($p<0.001$).

Conclusion: In patients with predicted DMV, the two-handed V-E technique is more effective than the two-handed E-C technique.

Keywords: Bag mask ventilation, two-handed E-C and V-E techniques, Difficult mask ventilation, Exhaled tidal volume and air-leak

LIST OF ABBREVIATIONS

µg	Microgram
AMBU	Artificial manual breathing unit
ASA	American society of Anaesthesiologists
AW	Actual body weight
BMI	Body mass index
BMV	Bag mask ventilation
CICO	Cannot Intubate Cannot Oxygenate
CO_2	Carbon dioxide
DMV	Difficult mask ventilation
ECG	Electrocardiogram
Etc	et cetra
$EtCO_2$	End tidal carbon dioxide
FiO_2	Fractional concentration of inspired oxygen
Kg	Kilogram
l/min	Liter per minute
mg	Milligram
ml	Milliliter
mmHg	Millimeter of mercury
MO	Mouth opening
MPS	Mallampati Score
MV	Minute ventilation
MVi	Inadequate mask ventilation
N	Sample size
NC	Neck circumference
NM blockade	Neuro muscular blockade
OSA	Obstructive sleep apnoea
PBW	Predicted body weight
PEEP	Positive end expiratory pressure

PIP	Peak inspiratory pressure
RE	Restricted extension
SD	Standard deviation
SpO_2	Oxygen saturation
SPSS	Statistical package for the social science
TE	Thenar eminence
TM	Thyromental distance
Vte	Exhaled tidal volume

KEYS TO MASTER CHART

ASA	American society of Anaesthesiologists
PBW	Predicted body weight
Vte	Exhaled tidal volume
Vte/PBW	Exhaled tidal volume/ Predicted body weight
Vte/AW	Exhaled tidal volume/ Actual weight
$EtCO_2$	End tidal carbon dioxide
PIP	Peak inspiratory pressure
MV	Minute ventilation
SpO_2	Oxygen saturation
BMI	Body mass index
OSA	Obstructive sleep apnoea
TM	Thyromental distance
MPS	Mallampati Score
Yr	Year
RE	Restricted extension
NC	Neck circumference
MO	Mouth opening

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INTRODUCTION

Bag mask ventilation (BMV) is a fundamental skill required for management of airway especially during apnoeic period at the time of induction of general anaesthesia.[1,2] This basic airway management technique allows for oxygenation and ventilation of patients until a more definitive airway can be established and acts as a rescue in cases where endotracheal intubation or other definitive control of airway is not possible. BMV is also indicated in hypoxic and hypercapnic respiratory failure, for ventilation and oxygenation in unconscious patients in emergency department and in patients with cardiac arrest.[3] Indeed, majority of difficult airway guidelines recommend BMV as a final rescue manoeuvre before declaring complete ventilation failure or Cannot Intubate, Cannot Oxygenate (CICO) situation.[4,5]

Cardiovascular collapse and irreversible brain injury are the life-threatening consequences of failure to oxygenate, failure to intubate situations which can be prevented by proper BMV.[6] Difficult mask ventilation (DMV), is a situation when an unassisted anaesthesiologist doing BMV is unable to maintain oxygen saturation >90% using 100% oxygen and positive pressure ventilation.[7] Inadequate mask ventilation (MVi) is defined as an average exhaled tidal volume of <4 ml/kg of predicted body weight (PBW) with clinical signs like inadequate chest rise, no fogging in the mask, no positive tracing of end-tidal carbon dioxide ($EtCO_2$), and/or lack of measurable exhaled tidal volumes on the anaesthesia monitor.[8]

Predictive factors for DMV include- age >46 years, male gender, high BMI>26 kg/m^2, bearded, edentulous, neck irradiation, short thyromental distance, restricted neck extension, neck circumference >40 cm and Mallampati score of 3 and 4.[9-16] Various aetiologies of DMV have been described which includes limited head extension, reduced pharyngeal patency due to deposition of fat, short neck, decreased chest wall compliance and limited diaphragmatic movements in obese patients.[17] In patients with history of snoring and OSA, DMV is attributed to airway

collapse specially under general anaesthesia due to multiple causes like obesity, enlarged tonsils/ adenoids, cranio-facial abnormalities, etc.[18] Age has been found to be closely correlated with an increased pharyngeal resistance to airflow in men but not in women, supporting the pre-dominance of OSA in men.[19] Other factors like male gender, short thyromental distance, MPS 3 and 4 and history of neck radiation are also related to DMV.[20-25]

Patients with predicted DMV are at higher risk of developing hypoxia because of increased air-leak. Significant air-leak has been defined as a difference of at least 33% between delivered tidal volume and exhaled tidal volume. Inappropriate mask size, inadequate mask seal, bearded male patients, edentulous are the common causative factors for increased air-leak, delivery of low tidal volume and hence DMV.[26] Thus, to form a proper seal thereby minimising air-leak, the smallest appropriately sized facemask is recommended. Proper fitting face mask also reduces dead space and eye compression. Therefore, effective mask ventilation can prevent and minimize air-leak in cases of predicted DMV.[27]

Different techniques have been described for holding the face mask during BMV to form an adequate seal and producing required tidal volume such as the one-handed E-C technique, the two-handed E-C technique and the two-handed V-E technique.[13] One handed E-C clamp technique is used commonly for BMV, and if ineffective, is superseded by two-handed E-C or V-E technique which provides a better mask-face seal[13,14] thus, minimizing air-leak and produces greater tidal volume.[15,16]

Compared with one-handed BMV, two-handed approaches provide better seal and produce greater tidal volumes but require an additional provider or a machine to deliver the positive-pressure breaths. Using mechanical ventilator to deliver positive-pressure breaths eliminates the need of an assistant by allowing use of both hands for BMV and also provides additional diagnostic information {e.g., minute ventilation (MV), peak and plateau pressures}.[28]

The two-handed E-C clamp technique incorporates use of thumb and index finger of both the hands to form a C shape over each side of the mask thereby, compressing the mask onto the face of patient. The third, fourth, and fifth finger of each hand lifts the lower jaw in a three fingered ‘E’ shape, thus forming better mask-face seal. The two-handed V-E technique uses the thumb and the thenar eminence of each hand placed over each side of the mask while the second to fifth fingers pull the jaw upward, again forming an ‘E’ shape.[29] These two techniques are considered as life saving techniques in predicted DMV and failed intubation.

A thorough literature search reveals few studies comparing the two-handed E-C technique and the two-handed V-E technique in real time clinical practice.[14,27] Gerstein et al conducted a study comparing these two techniques of BMV and observed improved ventilation in the two-handed thenar eminence (TE) grip over the two-handed E-C technique.[14] The study did not include patients with expected difficult endotracheal intubation. These findings of superiority of two-handed TE technique was further validated by investigators who evaluated a modification of TE technique, called modified V-E technique in obese patients. **Fei M** et al. compared the effectiveness of two-handed C-E clamp with two-handed modified V-E technique for mask ventilation in 81 obese unconscious apnoeic adults in a randomized crossover manner after induction of general anaesthesia. The primary outcome studied was the exhaled tidal volume (Vte). The modified V-E technique produced larger tidal volume than the C-E technique in all patients irrespective of success or failure of BMV. This study concluded that mask ventilation using the modified V-E technique is more effective than the C-E technique with a failure rate of 44% with C-E technique and 0% for V-E technique ($p<0.001$).[27] As these studies were conducted either on easy to ventilate or unconscious obese apnoeic adults, we proposed to compare the two-handed E-C technique with two-handed V-E technique in adult patients with predictors of anticipated DMV scheduled for elective and/or emergency surgery under general anaesthesia.

AIMS AND OBJECTIVES

To compare the efficacy of two-handed E-C clamp with two-handed V-E technique of BMV in patients with predicted DMV in terms of –

a) Exhaled tidal volume (Vte)

b) End tidal CO_2 ($EtCO_2$)

c) Peak inspiratory pressure (PIP)

d) Air-leak

e) Minute ventilation (MV)

f) Plateau pressure

g) Oxygen saturation (SpO_2)

REVIEW OF LITERATURE

The literature of artificial ventilation techniques begins with the mouth-to-mouth ventilation and the use of bellows from the mid-1500s until the early 1900s.[30] At the middle of the 20th century, several unidirectional valves were developed with different technical characteristics. These unidirectional valves improved the synchronization between the inspiratory effort of the patient and the delivered gas flow.[31]

In 1953, German doctor Holger Hesse and his partner Danish anesthetist Henning Ruben developed the original bag-valve -mask.[31] This manual resuscitator, also named as AMBU (Artificial Manual Breathing Unit), was manufactured and marketed in 1956 by their company (Testa laboratory). The company later changed its name to AMBU international. It's the world's first self-inflating resuscitator and a major milestone in emergency medical equipment. This marked the beginning of BMV.[32]

Since the introduction of the manual resuscitator and the technique of BMV, airway management has witnessed a major breakthrough both in emergent and non-emergent scenarios where the patient needs ventilation and oxygenation. The importance of the BMV cannot be overstated as it is not the inability to intubate that causes morbidity, but the inability to ventilate the patient.

DMV occurs in 1.4% (range 0.9–7.8%) of patients undergoing general anaesthesia and 4–11% of patients in the emergency room.[2] Incidence of DMV has also been reported by Han *et al.* (1.5%) , Asai et al. (1.4%), and 0.9% by Rose and Cohen.[33] Langeron *et al.* reported the 5 % incidence of grade 3 BMV in a study conducted on 1,502 adult patients.[34] One or more of the following reasons have been attributed for inadequate ventilation in cases of DMV: inadequate mask seal, excessive gas leak, excessive resistance to the flow of gas or lack of expertise.[35]

A 2004 classification and description scale developed by Han et al suggests grades (0-4) for BMV: grade 0 (mask ventilation not attempted), grade 1 (ventilation by mask), grade 2 (ventilation by mask with adjunct), grade 3- DMV (inadequate BMV or requiring 2 practitioners), and grade 4 (unable to ventilate).[36]

Khetarpal et al in their multivariate regression analysis identified the independent predictors of DMV which included BMI of 30 kg/m^2 or greater, beard, mallampati classification III or IV, age of 46 yr or older, thyromental distance of less than 6 cm, severely limited jaw protrusion, and snoring.[33] Langeron et al in a multivariate analysis identified 5 independent factors for DMV (age >55 years, BMI > 26 kg/m^2, beard, edentulous patients, history of snoring). They established a simple risk score which more accurately predicted DMV.[34]

According to a report by American Society of Anesthesiology (ASA), problem in BMV occurs when an anaesthesiologist cannot manage ventilation due to one or more of the issues such as insufficient coverage of mask on face, air-leak or high resistance to air stream. Therefore, appropriate coverage of mouth and nose with the mask is of utmost importance to efficiently ventilate the patient without any complications.[37]

Various methods for reducing air-leak in patients with predictors of DMV has been postulated and studied. Use of clear occlusive plastic or water-soluble lubricant to flatten beard hairs improves mask seal thus facilitating BMV. In obese patients, “Ramp” positioning prior to induction helps in establishing a more direct airway and helps in both BMV and laryngoscopy. Oral and/or nasal airway insertion can assist BMV in old age to overcome decreased muscle tone, decreased tissue elasticity and air-leak due to loss of teeth. Poor mask-face seal in edentulous patients as a consequence of lack of teeth makes BMV challenging and to overcome this problem, several techniques including small oral and nasal masks, oral airways, leaving dentures in

place and placement of a folded gauze in the buccal cavities during induction of general anaesthesia have been practiced.[35,38,39,40]

Above mentioned modifications to optimize BMV though aids in minimizing air-leak, however needs an expertise in the techniques of delivering effective BMV. Among the various techniques used for BMV two-handed BMV has proven to be more efficient at providing greater tidal volumes with less air-leak than one handed BMV. **Soleimanpour** et al in their study highlighted 3 main problems with inadequate ventilation which included inadequate air stream, lack of oxygen and gastric distension and these problems can be minimized by two-handed BMV.[35] Use of sniffing position and jaw thrust along with two-handed techniques further assists in successful BMV. Thus, several investigators have emphasized on studying and comparing different techniques of mask holding (one-handed with one-handed, one-handed with two-handed and two-handed with two-handed) in clinical as well as non-clinical mannequin-based settings.

Umesh et al compared the traditional one-handed E-C with E-O in which first and second finger like O letter covers mask entrance hole and three other fingers cover chin. They concluded that novice personnel can perform E-O technique better than E-C technique.[41]

Stephane X Racine et al conducted a study to evaluate inadequate seal and air-leak during two-hand positive-pressure face mask ventilation in forty-nine edentulous patients. In the presence of air-leak the caudal end of the mask was placed above the lower lip while maintaining the head in extension. He concluded that in edentulous patients the placement of face mask in lower lip position with two hands markedly reduced the air leak and improved ventilation.[26]

Joffe AM et al compared two-handed jaw-thrust technique to the one-handed EC-clamp technique for mask ventilation in forty-two elective surgical patients after induction of anesthesia in randomized, crossover fashion. Differences in minute ventilation and tidal volume of both the techniques were assessed. The authors concluded that two-handed

jaw-thrust mask technique improves upper airway patency which is measured by greater tidal volumes during pressure-controlled ventilation than a one-handed EC-clamp technique in the unconscious apneic patients.[15]

Hart D et al performed a prospective randomized study in which three techniques of face mask ventilation were compared based on median exhaled tidal volume and proximal peak flow pressure. This was a mannequin study in which a standard airway-training mannequin was modified to produce variable airway resistance. To achieve this, the distal trachea of the mannequin was attached to a 3/4th-inch internal-diameter vinyl tube connected to a water column. This model provided a quantifiable amount of distal tracheal airway pressure via hydrostatic forces created by altering the height of the water column. A standardized height of 55 cm H_2O was used, as it created a simulation in which BMV was difficult, but not impossible. A standard ventilator was used to deliver a fixed volume of 500 ml at a rate of 10 breaths/min to a standard transparent disposable plastic face mask with a high-volume, low pressure cuff. Each subject performed face mask ventilation for 3 min per technique (30 breaths) in a randomized order. The investigators observed that both two-handed ventilation techniques were more effective than the one-handed technique by both volume and pressure measurements. One-handed C-E technique yielded a median volume of 428.4 ml, vs. 550.8 ml with the two-handed C-E technique, and 538 ml with the two-handed V-E technique ($p<0.001$). Peak pressure measurements revealed a median of 54.6 cm H_2O for the one-handed C-E technique, 66 cm H_2O for the two-handed C-E technique, and 66.6 cm H_2O for the two-handed V-E technique ($p<0.001$).[13] Thus, they concluded both two-handed BMV techniques were superior to one-handed technique.

Gerstain et al in their prospective, randomized, crossover study compared the traditional E-C clamp (EC) grip with thenar eminence

(TE) technique to determine which of two facemask grip techniques for two-person facemask ventilation was more effective in novice clinicians. In a crossover manner, subjects performed each facemask ventilation technique (EC and TE) for one minute (12 breaths/min). Patients included in the study were adults over age 18 years, presenting for elective surgery requiring general anaesthesia. Exclusion criteria included emergency surgery, expected difficult endotracheal intubation, supraglottic airway insertion, full stomach, or the need for rapid-sequence intubation for any reason. The ventilator delivered a fixed 500 ml tidal volume. No neuromuscular blocking agents were administered. The investigator recorded all data manually from the anaesthesia machine's ventilator readout. Recorded data included Vte and peak inspiratory pressure (PIP) for each breath. The primary outcome was the Vte. As a secondary outcome, they examined mean peak inspiratory pressure (PIP). The TE grip resulted in mean Vte of 339 ml vs 221 ml for the EC grip. There was no significant difference in PIP values using the two grips: 14.2 (7.0) cm H_2O for TE, and 13.5 (9.0) cm H_2O for EC (p= 0.49).[14] They found that novices generated greater Vte and fewer failed breaths with the TE grip as compared to EC technique.

Soleimanpour M et al conducted a case-control and mannequin based study titled comparison of four techniques on facility of two-handed BMV: E-C, Thenar Eminence, Thenar Eminence (dominant hand) -E-C (non-dominant hand) and Thenar Eminence (non-dominant hand) - E-C (dominant hand) in which 120 volunteers were recruited and divided into two groups. Sixty participants were included in the experienced provider and other group had 60 novice providers. These novice providers had previously observed BMV but did not have the practical experience about it. Two experienced examiners who were blind to the ventilation process assessed the quality of mannequin chest expansion. They found that the novice group performed Thenar Eminence (non-dominant hand) - E-C (dominant hand) technique much better than the other techniques.[42]

Sato S et al conducted a study on BMV during induction of general anaesthesia in obese patients with sleep-disordered breathing (n = 42) and non sleep-disordered breathing (n = 38). The efficiency of BMV was assessed by the number of breaths needed to initially exceed 5 ml/kg ideal body weight of expiratory tidal volume (primary outcome) and tidal volumes (secondary outcomes) during initial 15 breaths. They found that one-handed BMV is difficult in patients with obesity and severe sleep-disordered breathing while the two-handed mask ventilation produces adequate tidal volume in these patients.[8]

Fei M et al conducted a study in which the authors compared the effectiveness of two-handed C-E clamp and modified V-E clamp technique for mask ventilation in obese unconscious apnoeic adults. Eighty-one obese adults received mask ventilation in a randomized crossover manner using C-E clamp and modified V-E clamp technique after induction of general anaesthesia. The primary outcome was Vte which was significantly lower for the C-E than the V-E technique. For the 81 subjects, the Vte was 371 (SD 345) ml for the C-E technique and 720 (244) ml for the V-E technique ($p<0.001$), peak airway pressures were 21 (SD 1.5) cm H_2O for the C-E technique and 21 (1.3) cm H_2O for the V-E technique. The failure rate was 44% with C-E technique as compared to V-E technique wherein no failed BMV was observed ($p<0.001$). Among those subjects who were effectively ventilated with both techniques, the modified V-E technique produced larger tidal volume than the C-E technique. Subjects who failed ventilation with the C-E technique could be ventilated effectively with the V-E technique. It was concluded that mask ventilation using the two-handed modified V-E technique is more effective than the two-handed C-E technique in unconscious obese apneic adults.[27]

Despite the presence of multiple techniques for hand positioning during BMV, this is an area which needs further investigation because there are only a few studies comparing the efficacy of these techniques in adults. Therefore, we have endeavored in our study to compare the

efficacy of two techniques, the traditional two-handed E-C technique vs two-handed V-E technique in adult patients who have predictors of difficult BMV.

MATERIALS AND METHODS

SOURCE OF DATA

A prospective, randomized, cross over study was conducted in the Department of Anaesthesiology, Dayanand Medical College and Hospital, Ludhiana after approval by Institutional Ethics Committee. A total of 400 adult patients scheduled for elective and emergency surgery under general anaesthesia were enrolled and randomly allocated into two study groups of 200 patients each. A written informed consent was obtained from each patient prior to the procedure.

METHOD OF COLLECTION OF DATA

Inclusion criteria-

All ASA I-III patients, 18 years and older who were scheduled for elective and emergency surgery under general anaesthesia with any of the following predictors of DMV:

- Body mass index (BMI)> 31 kg/m^2
- Edentulous
- Snoring
- Obstructive sleep apnea (OSA)
- Bearded
- History of neck radiation
- Short thyromental distance <6 cm
- Mallampati score of 3 and 4

Exclusion criteria-

- Untreated Ischemic heart disease
- Acute and chronic respiratory disorders including chronic obstructive pulmonary disease and asthma
- ASA Physical Status Classification ≥ IV
- Induction requiring rapid sequence for intubation
- Pregnant Women
- Patients requiring an awake intubation
- Ryle's tube insitu

Randomization and group allocation-

A total of 400 patients were randomized into two groups. Randomization was done by computer generated randomization codes contained in sealed, sequentially numbered envelopes.

Group A: Comprised of 200 patients who were first ventilated with E-C technique and then crossed-over to V-E technique as per figure 1.

Group B: Comprised of 200 patients who were first ventilated with V-E technique and then crossed-over to E-C technique as per figure 1.

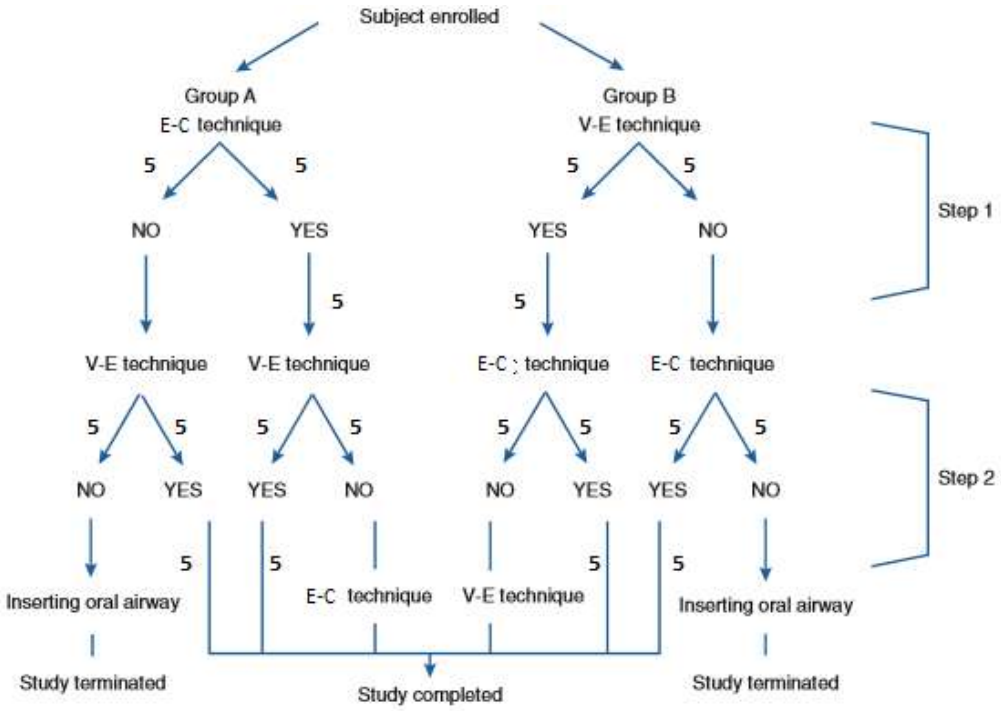


Figure-1: The algorithm of the study design. The numbers listed on the chart represent the number of breaths. At each step, 10 breaths were targeted.

NO: ineffective mask ventilation as assessed clinically by no visible chest rise, with no exhaled CO_2 measurement or Vte of <4ml/kg in all of the five breaths;

YES: effective mask ventilation as assessed clinically by visible bilateral chest rise, exhaled CO_2 measurement and Vte of >4ml/kg in atleast one of the five breaths.

METHODOLOGY:

All adult patients who were scheduled for elective or emergency surgery under general anaesthesia and fulfilled the inclusion criteria were included in the study after pre-anaesthesia assessment with detailed airway examination. After obtaining an informed written consent the patient was shifted to operating room.

In the operating room, standard monitors including ECG, pulse-oximeter, non-invasive blood pressure and capnography were applied. BMV was performed by trained anaesthesia consultants with experience of more than 5 years. All trained anaesthesia consultants were provided with brief instructions before induction with a photograph for each technique (fig.2). After receiving premedication, pre-oxygenation was carried out using appropriately sized face mask (size 3, 4, 5 transparent Drager silicone mask) with FiO_2 of 1.0 at the flow rate of 10 litres/min of oxygen. Face mask was chosen to achieve the best fit for patient and induction of anaesthesia was commenced with intravenous injection of fentanyl (1-2 µg/kg) and injection propofol (1-2 mg/kg) followed by injection atracurium (0.5 mg/kg). Additional boluses of propofol were administered by the attending anaesthesiologist based on clinical assessment of continued need for appropriate sedation during the study period. Ventilator was set to volume control mode (VCV) providing ventilation at a rate of 10 breaths per minute, tidal volume of 7 ml/kg of PBW and no PEEP (Drager Fabius plus ventilator). After apnoea, patients were randomized into either group as per random number list. In group A, patients were first ventilated with E-C technique and if ventilation was adequate as defined by bilateral chest rise and exhaled CO_2 measurement and Vte >4ml/kg of PBW in atleast one of the first five breaths, it was continued for 10 breaths followed by cross-over to 10 breaths with V-E technique. If ventilation failed for all five consecutive breaths with E-C technique, patient was crossed over to V-E technique. If ventilation with V-E was successful then additional 5 breaths were delivered with the same technique. However, failure to ventilate with the cross-over V-E technique led to the termination of the study and ventilation was continued with adjuncts

like insertion of oral or nasal airway. After ventilating for 2.5-3 minutes laryngeal mask airway insertion or endotracheal intubation was done. The same protocol was followed in group B except that V-E technique was crossed-over to E-C technique.

DATA COLLECTION

In both the groups, following parameters were assessed and recorded:

a) Exhaled tidal volume (Vte)

b) End tidal CO_2 ($EtCO_2$)

c) Peak inspiratory pressure (PIP)

d) Air leak

e) Minute ventilation

f) Plateau pressure

g) Oxygen saturation (SpO_2)

The final analysis was done by calculating the mean of first five breaths in failed ventilation and mean of all ten breaths in successful ventilation. Mean of these values was used as single data point.

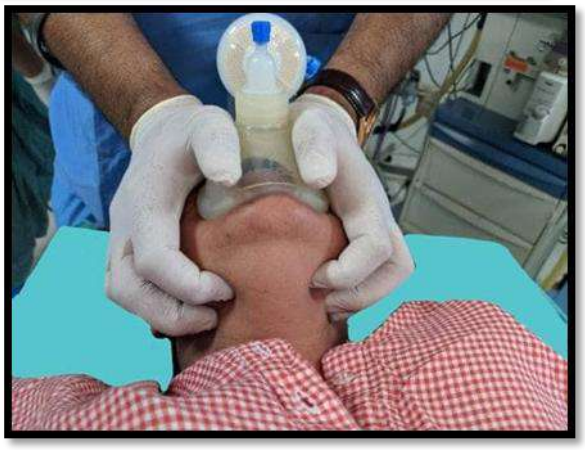
	Two handed E-C clamp in which thumb and index finger of both the hands form C shape over each side of the mask while the third, fourth, and fifth fingers of each hand lifts the lower jaw in a three fingered 'E' shape.
	**Two handed V-E technique uses the thumb and the thenar eminence of each hand placed over each side of the mask while the second to fifth fingers pull the jaw upward, again forming an 'E' shape.**

Figure-2: Demonstration of two-handed techniques of BMV

SAMPLE SIZE:

Based on results of previous study,[27] we calculated a sample size of 196 patients in each group to detect a 100ml difference in mean exhaled tidal volume (Vte) assuming SD of 350 ml and type-1 error of 5% for 80% power of study. The following formula was used for sample size calculation:

$N=16/E^2$

Effect Size (E): (Difference between the means)/SD

According to the above assumption a sample size of 196 patients for each group was calculated. Hence, we included 200 patients in each group.

OUTCOME:

The primary outcome analysed in our study was:

- Exhaled tidal volume (Vte)

The secondary outcomes analysed were as follows:

- Vte / actual weight (Vte/AW), Vte/PBW
- Air-leak (calculated by subtracting exhaled tidal volume from delivered tidal volume. Significant air-leak was defined as difference of atleast 33% between delivered tidal volume and exhaled tidal volume)[26]
- PIP
- Minute ventilation
- Plateau pressure
- $EtCO_2$
- SpO_2

STATISTICAL ANALYSIS: Data obtained was described in terms of mean ± standard deviation (± SD), frequencies (number of cases) and relative frequencies (percentages) as appropriate. Paired t-test, Wilcoxon-Rank test, Student-t test and Mann-Whitney test were used for comparing quantitative outcomes, and McNemar's test was used to compare categorical outcomes with respect to mask ventilation technique. Also, for comparing categorical data, Chi square ($\chi 2$) test was performed and exact test was used when the expected frequency is less than 5. A probability value (p value) less than 0.05 was considered statistically significant. All statistical calculations were done using SPSS 21 (Statistical Package for the Social Science) version statistical program for Microsoft Windows.

OBSERVATIONS AND RESULTS

In our randomized, prospective, cross-over study 400 patients were enrolled and divided into two groups (Group A & Group B) for final analysis. The detailed information regarding enrolment and flow of subjects in study protocol is provided in the figure 1. All the patients underwent BMV with both two-handed E-C & V-E techniques in a cross-over fashion.

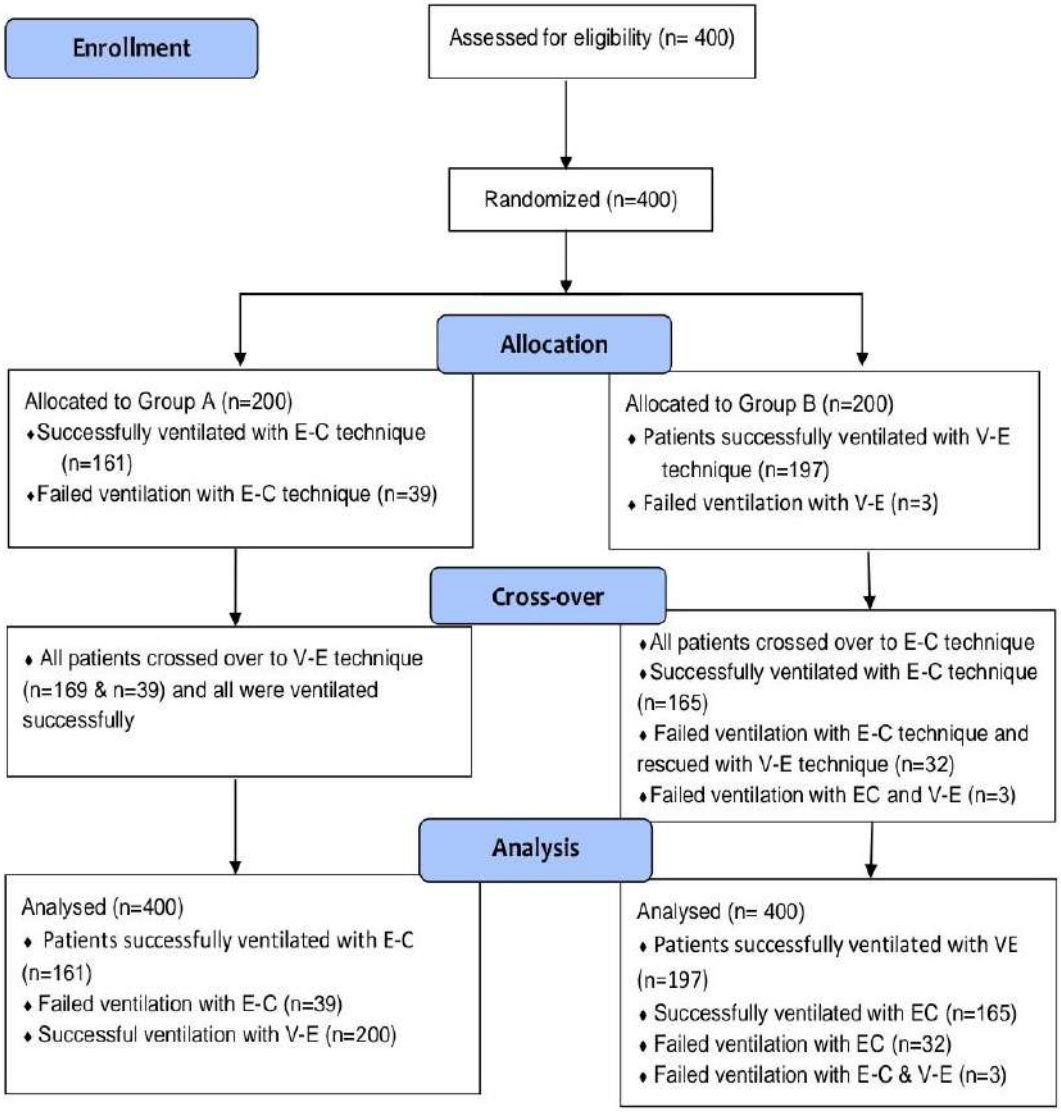

Enrollment
Assessed for eligibility (n= 400)
Randomized (n=400)
Allocation
Allocated to Group A (n=200)
♦Successfully ventilated with E-C technique (n=161)
♦Failed ventilation with E-C technique (n=39)
Allocated to Group B (n=200)
♦ Patients successfully ventilated with V-E technique (n=197)
♦ Failed ventilation with V-E (n=3)
Cross-over
♦ All patients crossed over to V-E technique (n=169 & n=39) and all were ventilated successfully
♦All patients crossed over to E-C technique
♦Successfully ventilated with E-C technique (n=165)
♦ Failed ventilation with E-C technique and rescued with V-E technique (n=32)
♦Failed ventilation with EC and V-E (n=3)
Analysis
Analysed (n=400)
♦ Patients successfully ventilated with E-C (n=161)
♦ Failed ventilation with E-C (n=39)
♦ Successful ventilation with V-E (n=200)
Analysed (n= 400)
♦ Patients successfully ventilated with VE (n=197)
♦ Successfully ventilated with EC (n=165)
♦ Failed ventilation with EC (n=32)
♦ Failed ventilation with E-C & V-E (n=3)

Figure-3. Consort Flow Diagram

Table-1. Comparison of demographic profile of patients in both groups

Characteristics	Group A	Group B	p-value	Chi-square value/ t-test
Age [year; mean]	51	53	0.199	-1.287
Sex Male Female	 127 73	 126 74	0.917	0.011
ASA Physical Status 1 2 3	 64 119 17	 65 118 17	0.994	0.012
Actual weight [kg;mean (SD)]	76.84 (14.60)	76.92 (15.02)	0.960	-0.051
Predicted body weight [kg;mean (SD)]	62.72 (9.09)	61.57 (9.29)	0.212	1.250
Height [cm; mean (SD)]	168.23 (7.84)	167.15 (8.26)	0.181	1.340
BMI [kg/m^2; mean (SD)]	26.80 (5.33)	27.22 (5.22)	0.431	-0.788

The demographic distribution of patients in both groups A & B was comparable with respect to age, sex, ASA physical status, weight (actual weight), predicted weight, height & BMI.

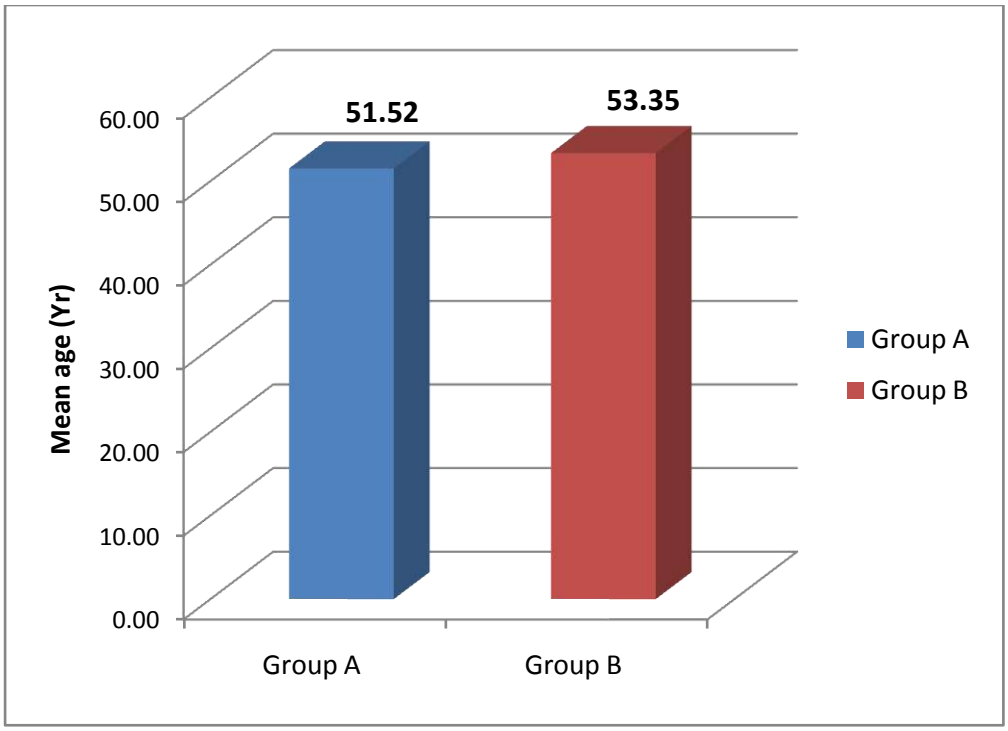


Figure-4. Distribution of age between two groups

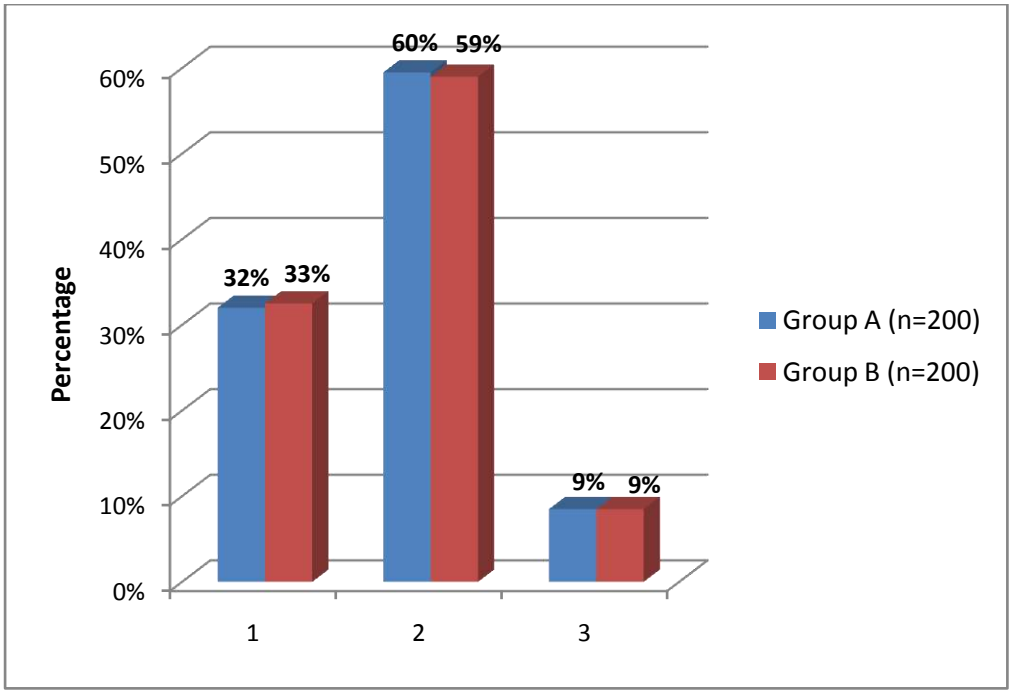


Figure-5. Distribution of ASA Physical status between two groups

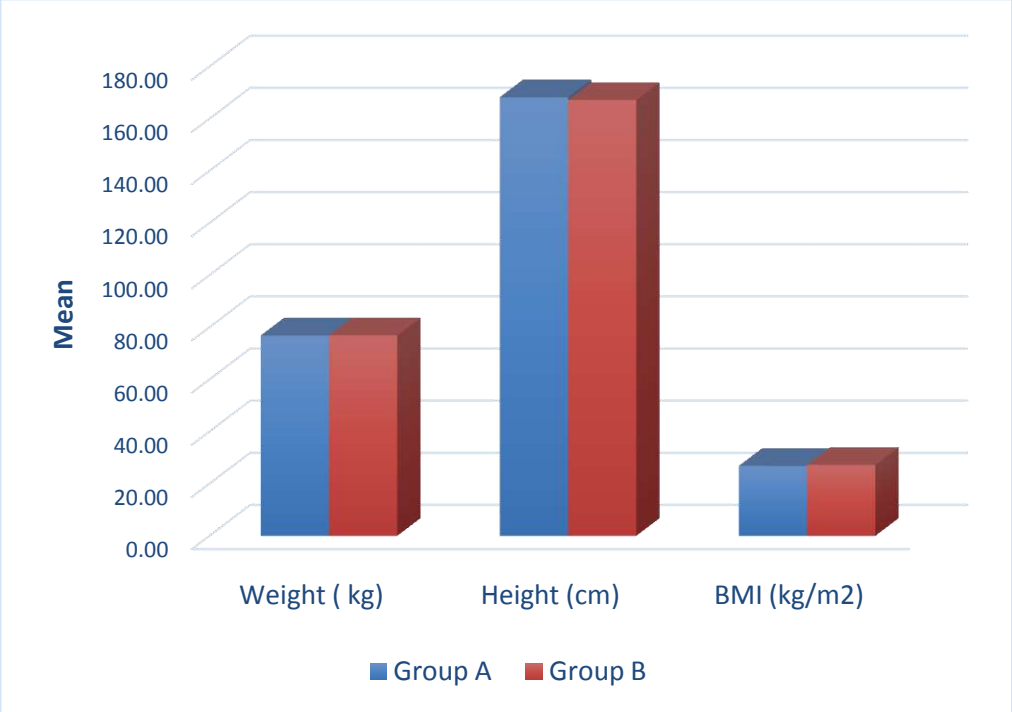


Figure-6. Distribution of actual weight, height & BMI between two groups

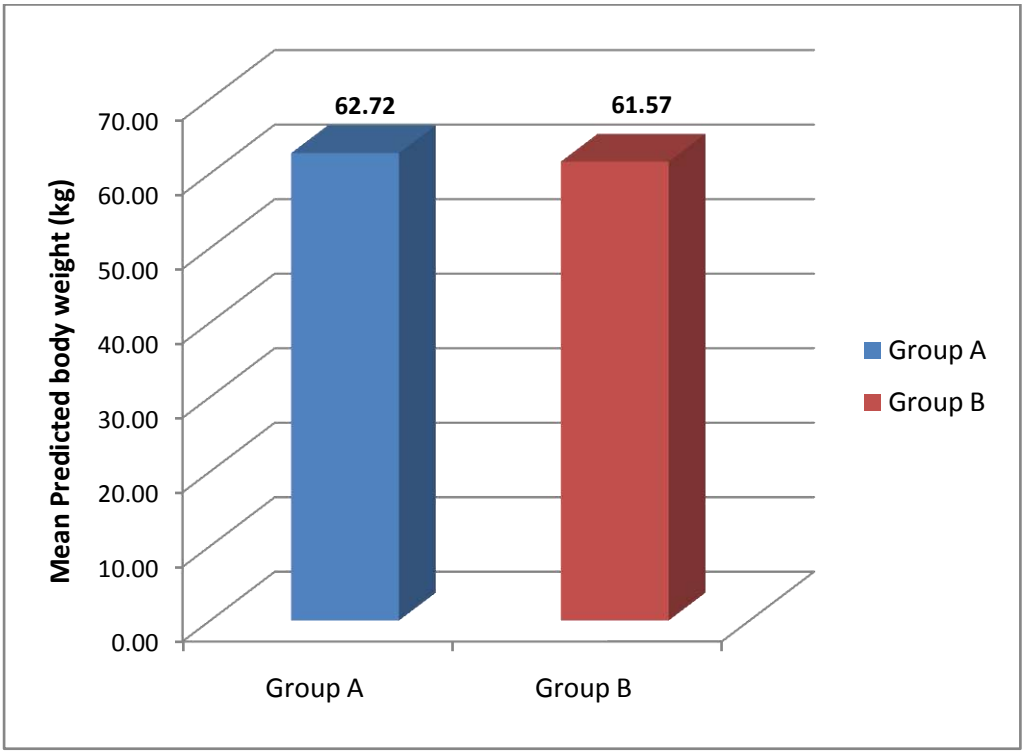


Figure-7. Mean Predicted Body Weight in two groups

Table-2. Distribution of patients with predictors of difficult mask ventilation (DMV) in both groups

Predictors of DMV	Group A (n=200)		Group B (n=200)		Total	Chi-Square	p-value
BM1 >31	41	21%	51	26%	92	1.412	0.235
Snoring	19	10%	19	10%	38	0.000	1.000
OSA	1	1%	2	1%	3	0.336	0.562
Beard	48	24%	44	22%	92	0.226	0.635
Edentulous	24	12%	29	15%	53	0.544	0.461
TM<6CM	5	3%	7	4%	12	0.344	0.558
MPS3	117	59%	104	52%	221	1.709	0.191
MPS4	29	15%	37	19%	66	1.161	0.281
Age> 51 years	107	54%	116	58%	223	0.821	0.365
Cervical collar	2	1%	2	1%	4	9.13	0.692
MO<2FB	1	1%	0	0%	1		
NC>40cm	4	2%	2	1%	6		
RE	2	1%	4	2%	6		

Patients included in our study had the following predictors of DMV: BMI >31 kg/m^2, snoring, OSA, beard, edentulous, neck circumference >40 cm, thyromental distance <6 cm, MPS 3 and 4. We observed additional predictors of DMV like age>51 years, MO<2FB, NC≥40cm and RE in our patients. There was no statistically significant difference in distribution of patients with these predictors between two groups.

Table 3A- Operator characteristics

Operator characteristic	**Group A**		**Group B**		**t**	**p-value**
	Mean	**SD**	**Mean**	**SD**		
Age (Years)	42.47	4.43	42.26	4.61	0.465	0.642

Table 3B- Operator experience (in years)

Operator experience (years)	**Group A**		**Group B**		**Chi-square value**	**p-value**
5-10	3	27%	3	27%	0.000	1.000
10-15	5	45%	5	45%	0.000	1.000
> 15	3	27%	3	27%	0.000	1.000

BMV was performed by 11 operators with an experience of more than five years who ventilated all patients recruited in the study. However, each patient was ventilated by not more than one operator. There was no significant difference in the age, level of operator experience between two groups.

Table-4. Distribution of patients in relation to overall success and failure of two techniques of BMV

	V-E		E-C		p-value
	No. of cases	Percentage	No. of cases	Percentage	
Success	397	99%	326	82%	< 0.001
Failure	3	1%	74	19%	
Total	400	100%	400	100%	

Overall 400 patients were enrolled in this cross over study wherein the failure rate with two handed E-C technique was 19% and 1% with two-handed V-E technique (p<0.001).

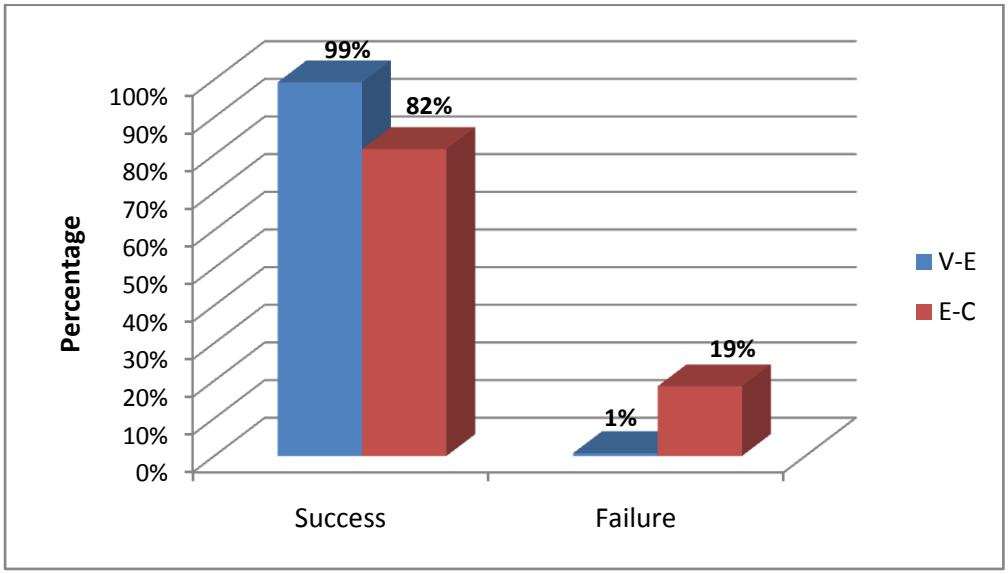


Figure-8. Graphical representation of patients in relation to overall success and failure of two techniques of BMV

Table-5. Presence of predictors of DMV in patients who experienced failed BMV

No. of predictors for DMV	Total no. of patients	No. of patients who experienced failed BMV	Percentage
1	112	4	4%
2	182	16	9%
3	86	38	44%
4	16	13	81%
5	3	2	67%
6	1	1	100%
Total	400	74	19%

We observed higher percentage of patients experiencing failed BMV in the presence of ≥ 3 predictors of DMV.

Table 6- Comparison of mean ventilatory parameters between V-E and E-C techniques (irrespective of success or failure)

Observed Parameter	VE (n=400)		EC (n=400)		t/Z	p-value	Difference		95% Confidence Interval of the Difference	
	Mean	SD	Mean	SD			Mean	SD	Lower	Upper
Vte/PBW (ml/kg)	6.12	0.63	4.91	1.57	-18.539	0.001	1.21	1.31	-1.34	-1.08
Vte/AW (ml/kg)	5.09	1.18	4.14	1.62	-18.701	0.001	0.95	1.02	-1.06	-0.85
Vte (ml)	378.41	58.40	303.09	103.45	18.298	0.001	75.32	82.32	67.22	83.41
Set tidal volume (ml)	436.30	64.48	436.30	64.48	-	-	-	-	-	-
$EtCO_2$ (mmHg)	26.70	5.47	21.89	7.85	15.446	0.001	4.81	6.23	4.20	5.42
MV (Litres/min)	3.77	0.63	2.99	0.99	19.267	0.001	0.78	0.81	0.70	0.86
PIP (cm H_2O)	15.48	2.95	16.16	4.29	-3.087	0.002	-0.68	4.41	-1.11	-0.25
Plateau (cm H_2O)	13.75	2.79	14.58	4.24	-4.168	0.001	-0.83	3.98	-1.22	-0.44
Air-leak (ml)	57.89	45.55	133.21	103.87	-18.298	0.001	-75.32	82.32	-83.41	-67.22
Air-leak %	12.80	8.95	30.05	22.40	-18.545	0.001	-17.25	18.60	-19.08	-15.42
SpO_2	100.0	0.0	100.0	0.0	-	-	-	-	-	-

In a statistical comparison of ventilatory parameters between V-E & E-C technique irrespective of failure or success of ventilation, we observed statistically significant higher Vte, $EtCO_2$, MV and lower air leak, mean PIP, plateau pressure with V-E technique as compared to E-C technique. All values reached statistical significance in comparative analysis except SpO_2.

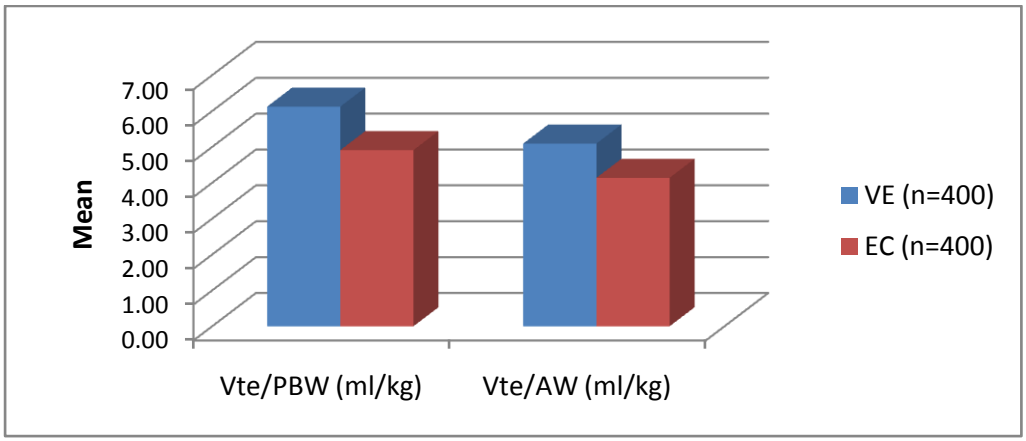


Figure-9. Overall mean of Vte/PBW & Vte/AW between V-E and E-C techniques in 400 patients (irrespective of success or failure)

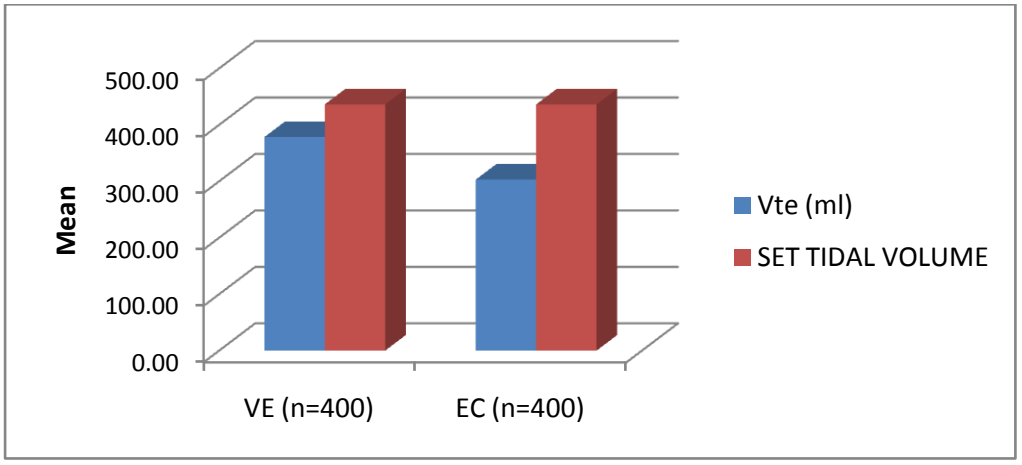


Figure-10. Overall mean Vte between V-E and E-C techniques in 400 patients (irrespective of success or failure)

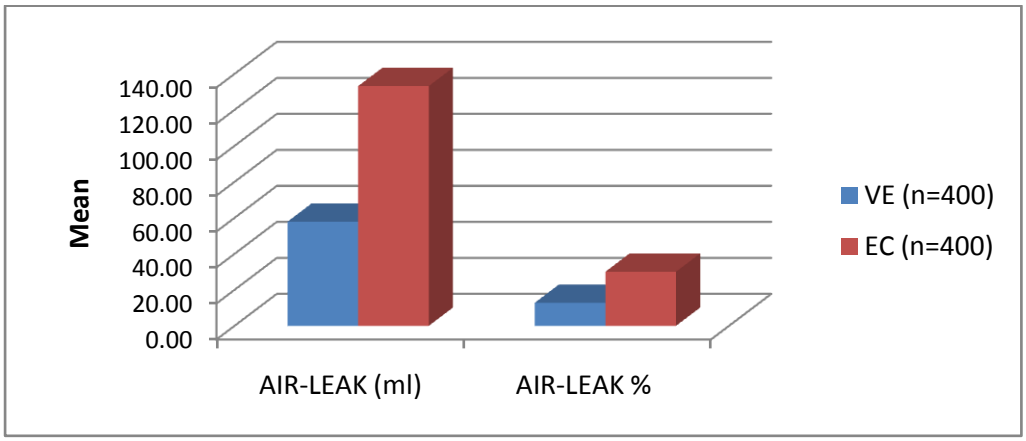


Figure-11. Overall mean air-leak between V-E and E-C techniques in 400 patients (irrespective of success or failure)

Table 7- Comparison of mean ventilatory parameters of patients ventilated successfully with both V-E and E-C techniques

Observed Parameter	VE (n=326)		EC (n=326)		t/Z	p-value	Difference		95% Confidence Interval of the Difference	
	Mean	SD	Mean	SD			Mean	SD	Lower	Upper
Vte/PBW (ml/kg)	6.25	0.48	5.55	0.68	-19.973	0.001	0.70	0.64	-0.77	-0.63
Vte/AW (ml/kg)	5.30	1.07	4.72	1.07	-19.621	0.001	0.59	0.54	-0.65	-0.53
Vte (ml)	386.88	56.10	342.89	55.64	20.147	0.001	44.00	39.43	39.70	48.29
$EtCO_2$ (mmHg)	26.92	5.67	24.27	5.74	15.407	0.001	2.65	3.10	2.31	2.98
MV (Litres/min)	3.87	0.61	3.37	0.51	17.581	0.001	0.50	0.51	0.44	0.55
PIP (cm H_2O)	15.71	3.07	17.14	3.20	-7.165	0.001	-1.42	3.59	-1.82	-1.03
Plateau (cm H_2O)	13.99	2.92	15.47	3.39	-8.024	0.001	-1.48	3.33	-1.84	-1.12
Air-leak (ml)	49.50	36.14	93.50	48.81	-20.147	0.001	-44.00	39.43	-48.29	-39.70
Air-leak %	10.96	6.92	20.98	9.76	-20.007	0.001	-10.02	9.04	-11.01	-9.04
SpO_2	100.0	0.0	100.0	0.0	-	-	-	-	-	-

The mean Vte [386.88 (SD 56.10) ml] for V-E technique was higher as compared to the mean Vte [342.89 (SD 55.64) ml] for E-C technique and this difference was found to be statistically significant. The mean $EtCO_2$ and mean MV for V-E technique were significantly higher as compared to E-C technique. The mean PIP, mean plateau pressure and air-leak for V-E technique were significantly lower as compared to E-C technique.

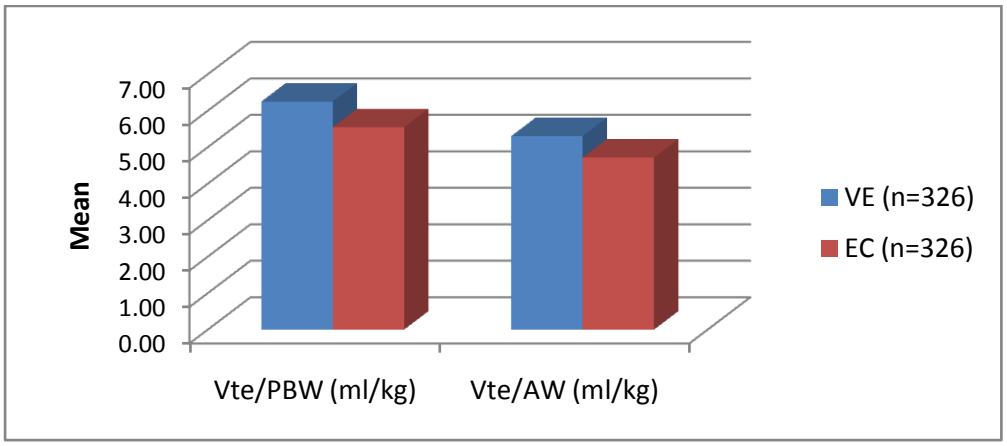


Figure-12. Mean of Vte/PBW & Vte/AW in patients who were ventilated successfully with both V-E and E-C techniques.

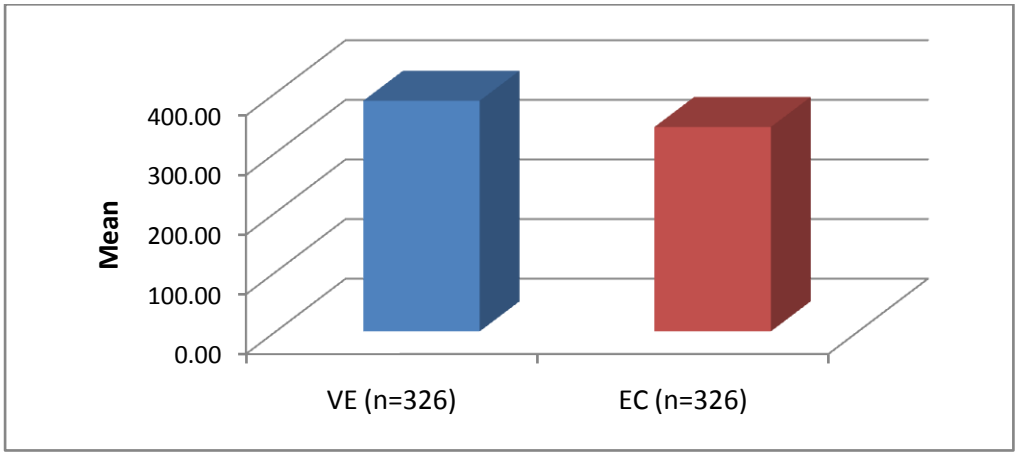


Figure-13. Mean Vte in patients who were ventilated successfully with both V-E and E-C techniques.

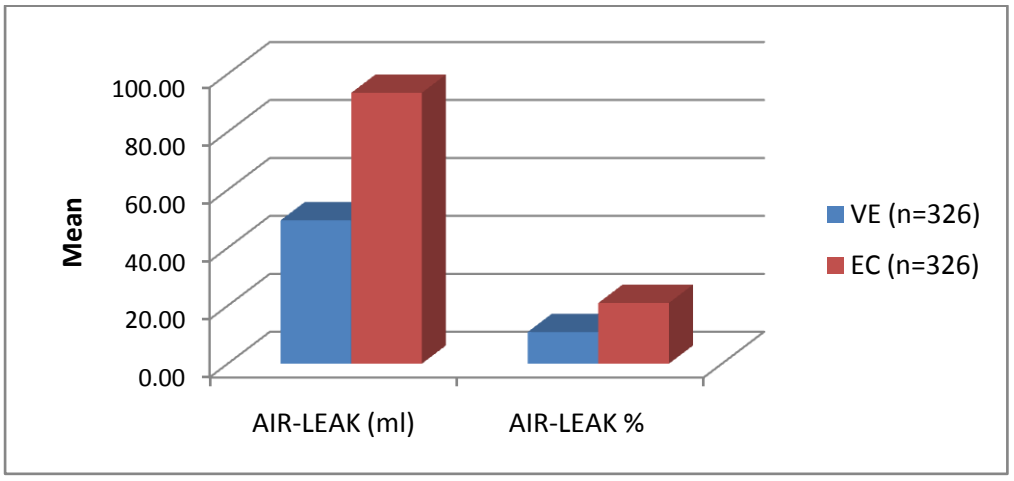


Figure-14. Mean air-leak in patients who were ventilated successfully with both V-E and E-C techniques

Table-8. Comparison of mean ventilatory parameters in patients who underwent successful BMV with E-C technique followed by successful V-E technique in **Group A**

Observed Parameter	EC (n=161)		VE (n=200)		t/Z	p-value	Difference		95% Confidence Interval of the Difference	
	Mean	SD	Mean	SD			Mean	Std. Error	Lower	Upper
Vte/PBW (ml/kg)	4.84	1.63	6.24	0.50	10.488	0.001	-1.40	0.13	1.14	1.66
Vte/AW (ml/kg)	4.10	1.66	5.30	1.05	7.988	0.001	-1.20	0.15	0.90	1.50
Vte (ml)	345.66	54.74	381.89	56.91	-6.116	0.001	-36.24	5.92	-47.89	-24.58
$EtCO_2$ (mmHg)	24.32	6.03	26.93	5.44	-4.312	0.001	-2.61	0.60	-3.80	-1.42
PIP (cm H_2O)	17.39	3.42	15.36	2.95	6.044	0.001	2.03	0.34	1.37	2.69
Plateau (cm H_2O)	15.65	3.59	13.66	2.88	5.852	0.001	1.99	0.34	1.32	2.66
MV (Litres/min)	3.39	0.50	3.82	0.66	-6.885	0.001	-0.43	0.06	-0.55	-0.31
Set tidal volume (ml)	441.61	62.91	440.55	63.44	0.159	0.874	1.06	6.69	-12.10	14.23
Air-leak (ml)	95.96	48.80	58.66	43.49	7.669	0.001	37.30	4.86	27.74	46.86
Air-leak %	21.31	9.79	12.89	8.43	8.779	0.001	8.42	0.96	6.54	10.31
SpO_2	100.0	0.0	100.0	0.0	-	-	-	-	-	-

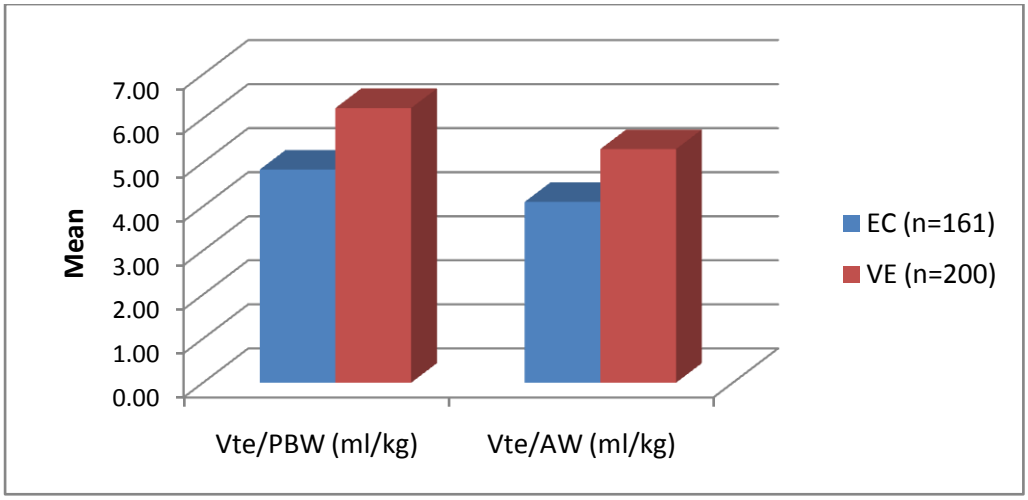


Figure-15. Mean of Vte/PBW & Vte/AW in patients who underwent successful BMV with E-C technique followed by successful V-E technique in Group A

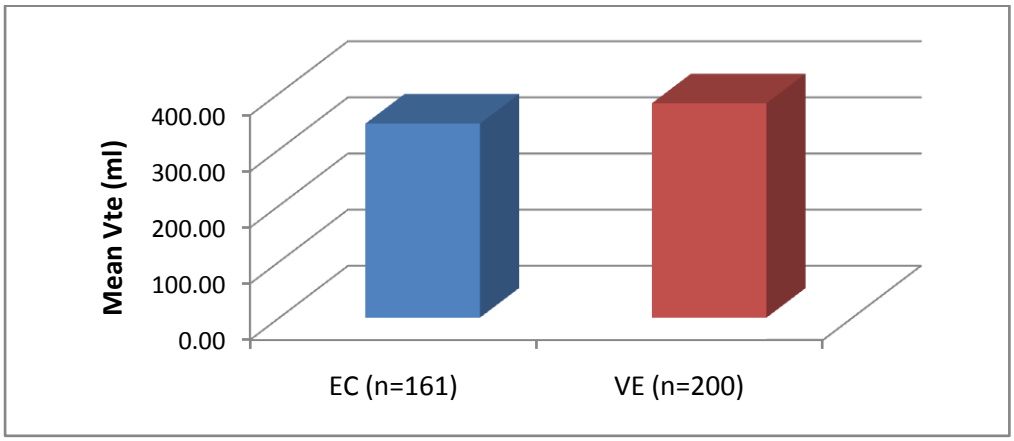


Figure-16. Mean Vte in patients who underwent successful BMV with E-C technique followed by successful V-E technique in Group A

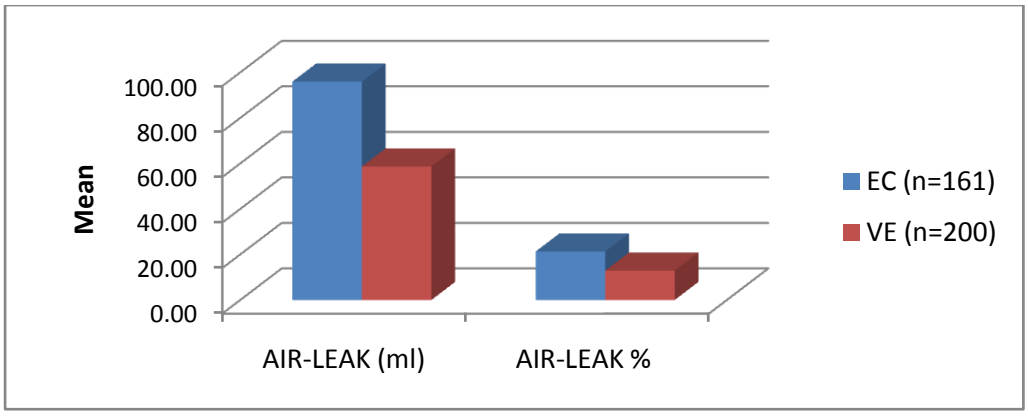


Figure-17. Mean air-leak in patients who underwent successful BMV with E-C technique followed by successful V-E technique in Group A

Patients in Group A were first ventilated with two-handed E-C technique and then crossed-over to two-handed V-E technique. Out of 200 patients, 161 were successfully ventilated with E-C technique and were crossed-over to V-E technique after 10 successful breaths, while 39 patients who failed ventilation were also crossed over to V-E technique after five failed breaths wherein all patients could be successfully ventilated.

The mean Vte [345.66 (SD 54.74) ml] for E-C technique was lower as compared to the mean Vte [381.89 (SD 56.91) ml] for V-E technique and the difference was statistically significant. The mean $EtCO_2$ [24.32 (SD 6.03) mmHg] and mean MV [3.39 (SD 0.50) L/min] for E-C technique were significantly lower as compared to mean $EtCO_2$ [26.93 (SD 5.44) mmHg] and mean MV [3.82(SD 0.66) L/min] for V-E technique. The mean PIP [17.39 (SD 3.42) mmH_2O], mean plateau pressure [15.65 (SD 3.59) mmH_2O] and air-leak [95.96 (SD 48.80) ml] for E-C technique were significantly higher as compared to the mean PIP [15.36 (SD 2.95) mmH_2O], mean plateau pressure [13.66 (SD 2.88) mmH_2O] and air-leak [58.66 (SD 43.49) ml] for V-E technique. Patients who failed BMV with E-C technique (n=39) when crossed over to V-E technique were ventilated successfully generating a mean Vte of 377.67 ml.

Thus, in group A

1. All subjects who failed mask ventilation with the E-C technique were ventilated effectively with the V-E technique
2. Failure rate with E-C technique was 20.5%
3. No failure was observed with V-E technique

Table-9. Comparison of mean ventilatory parameters in patients who underwent successful BMV with V-E technique followed by successful BMV with E-C technique in **Group B**

Observed Parameter	VE (n=197)		EC (n=165)		t/Z	p-value	Difference		95% Confidence Interval of the Difference	
	Mean	SD	Mean	SD			Mean	Std. Error	Lower	Upper
Vte/PBW (ml/kg)	6.27	0.46	5.05	1.41	10.616	0.001	1.21	0.11	0.99	1.44
Vte/AW (ml/kg)	5.30	1.09	4.23	1.52	7.571	0.001	1.07	0.14	0.79	1.35
Vte (ml)	377.39	56.74	340.18	56.54	-6.224	0.001	-37.21	5.98	-48.97	-25.45
$EtCO_2$ (mmHg)	26.56	5.46	24.22	5.45	-4.067	0.001	-2.34	0.58	-3.48	-1.21
MV (Litres/min)	3.75	0.57	3.35	0.51	-6.814	0.001	-0.39	0.06	-0.51	-0.28
PIP (cm H2O)	15.62	2.98	16.89	2.97	4.051	0.001	1.27	0.31	0.65	1.89
Plateau (cm H2O)	13.87	2.72	15.30	3.18	4.583	0.001	1.42	0.31	0.81	2.03
Air-leak %	12.05	7.85	20.65	9.76	9.297	0.001	8.60	0.93	6.78	10.42
Air-leak (ml)	53.83	39.60	91.09	48.85	8.015	0.001	37.26	4.65	28.12	46.41
SpO_2	100.0	0.0	100.0	0.0	-	-	-	-	-	-

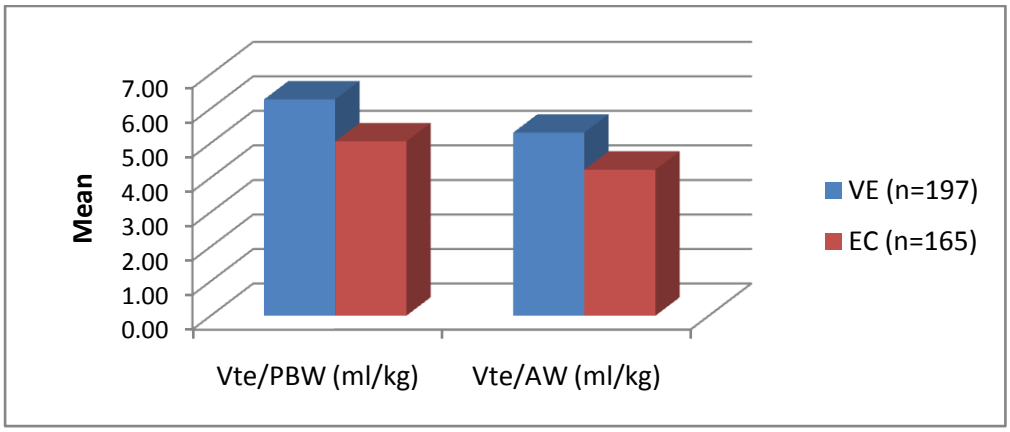


Figure-18. Mean of Vte/PBW & Vte/AW in patients who underwent successful BMV with V-E technique followed by successful BMV with E-C technique in Group B

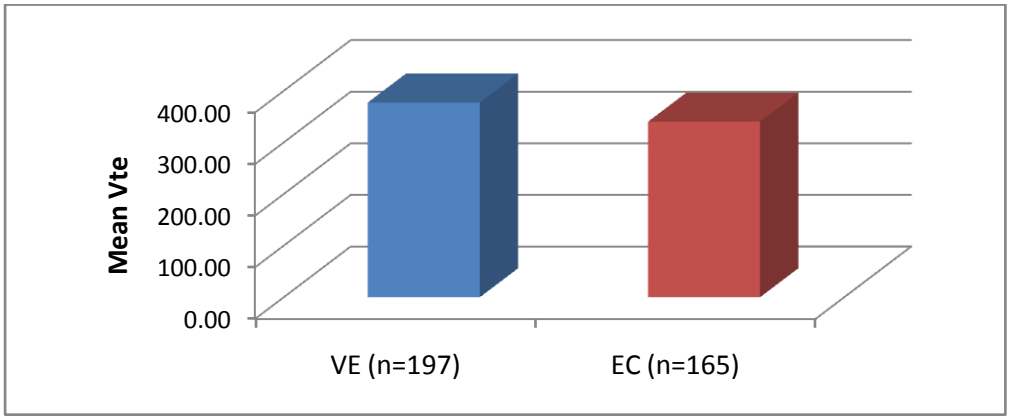


Figure-19. Mean Vte in patients ventilated successfully BMV with V-E technique followed by successful BMV with E-C technique in group B

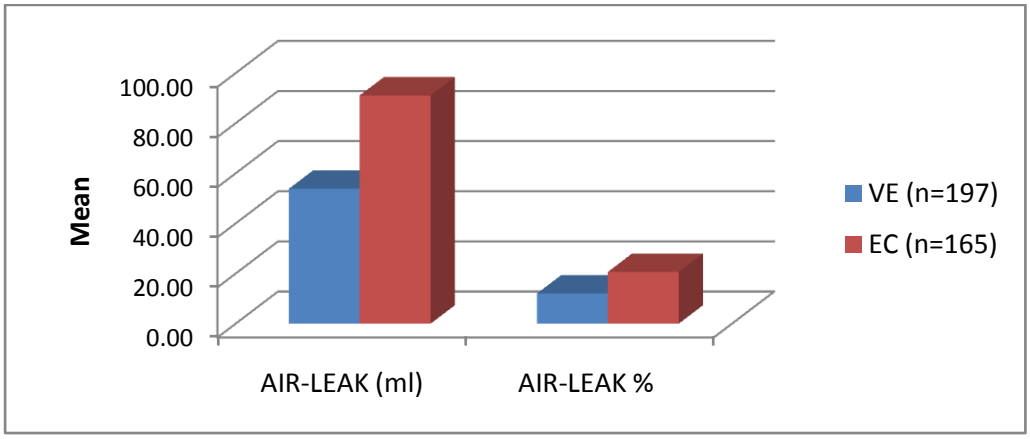


Figure-20. Mean air-leak in patients who underwent successful BMV with V-E technique followed by successful BMV with E-C technique in Group B

In Group B, 200 subjects started BMV with the V-E technique of which 197 were successfully ventilated and 3 of them had failed mask ventilation. After cross-over to E-C technique we observed failed BMV in 32 patients which were successfully rescued with V-E technique. Three patients who had failed BMV with V-E technique also experienced failed BMV with E-C technique. These three patients were rescued with the use of airway adjuncts. So, patients successfully ventilated with V-E technique were 197 and those with E-C technique were 165 in group B.

It was found that V-E technique yielded higher mean Vte [377.39 ml (SD 56.74)], mean $EtCO_2$ [26.56 (SD 5.46) mmHg], mean MV [3.75 ml (SD 0.57)], mean Vte/AW [4.23 ml/kg (SD 1.52)], mean Vte/PBW [5.05 ml/kg (SD 1.41)] and yielded lower air-leak [53.89 ml (SD 39.60)], mean PIP [15.62 cm H_2O (SD 2.98)] and plateau pressure [13.87 cm H_2O (SD 2.72)].

The E-C technique on the other hand yielded lower mean Vte [340.18 ml (SD 56.54)], mean $EtCO_2$ [24.22 mmHg (SD 5.45)], MV [3.35 ml (SD 0.51)], mean Vte/AW [5.30 ml/kg (SD 1.09)], mean Vte/PBW [6.27 ml/kg (SD 0.46)] and higher air-leak [91.09 ml (SD 48.85)], mean PIP [16.89 cm H_2O (SD 2.97)], and higher mean plateau pressure [15.30 cm H_2O (SD 3.18)]. All values except SpO_2 reached statistical significance (p value < 0.05).

Table- 10. Comparison of mean ventilatory parameters of patients who had failed BMV with E-C technique and were rescued with V-E technique in **group B**

Observed Parameter	EC (n=32)		VE (n=32)		t/Z	p-value	Difference		95% Confidence Interval of the Difference	
	Mean	SD	Mean	SD			Mean	SD	Lower	Upper
Vte/PBW (ml/kg)	5.49	0.67	5.68	0.66	2.771	0.009	-0.18	0.37	0.05	0.32
Vte/AW (ml/kg)	3.90	0.94	4.02	0.92	2.991	0.005	-0.13	0.24	0.04	0.21
Vte (ml)	144.55	74.44	336.18	49.93	-14.239	0.001	-191.63	76.13	-219.08	-164.18
$EtCO_2$ (mmHg)	12.62	6.99	25.53	4.62	-11.023	0.001	-12.91	6.63	-15.30	-10.52
MV (Litres/min)	1.45	0.77	3.37	0.52	-13.312	0.001	-1.91	0.81	-2.21	-1.62
PIP (cm H_2O)	11.80	4.71	14.33	1.68	-2.895	0.007	-2.54	4.96	-4.32	-0.75
Plateau (cm H_2O)	10.69	4.33	13.06	2.34	-2.739	0.010	-2.37	4.89	-4.13	-0.61
Air-leak (ml)	286.39	91.24	94.76	46.22	14.239	0.001	191.63	76.13	164.18	219.08
Air-leak %	65.97	16.49	21.56	9.56	15.938	0.001	44.40	15.76	38.72	50.09
SpO_2	100.0	0.0	100.0	0.0	-	-	-	-	-	-

After cross over, 32 out of 197 patients had failed ventilation using E-C technique [mean Vte: 144.55 (SD 74.44) ml] and were rescued successfully with V-E technique [mean Vte: 336.18 (SD 49.13) ml] ($p<0.001$). Air-leak was found to be statistically higher in 32 patients [286.39 (SD 91.24)] ml who had failed ventilation with two handed E-C technique which significantly reduced to 94.76 (SD 46.22) ml when rescued with V-E technique. All values reached statistical significance (p value < 0.001) except SpO_2.

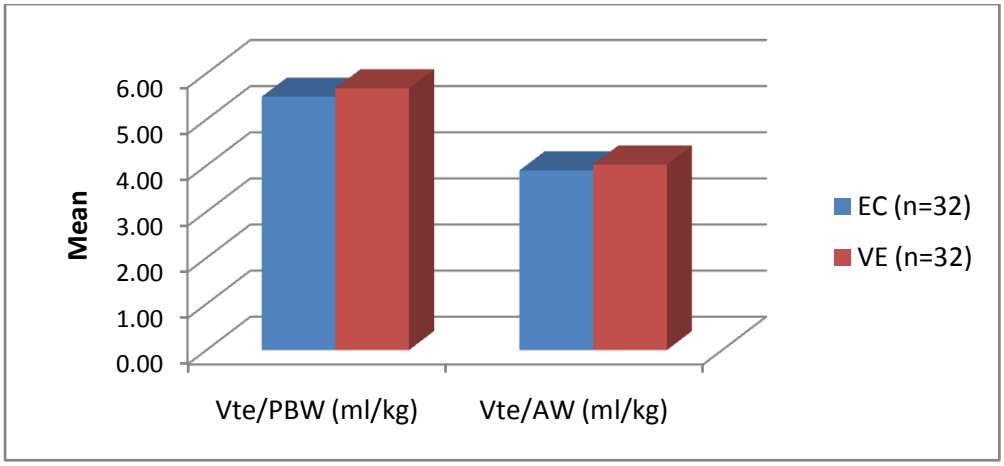


Figure- 21. Mean of Vte/PBW & Vte/AW in patients who failed BMV with E-C technique and were rescued with V-E technique in Group B

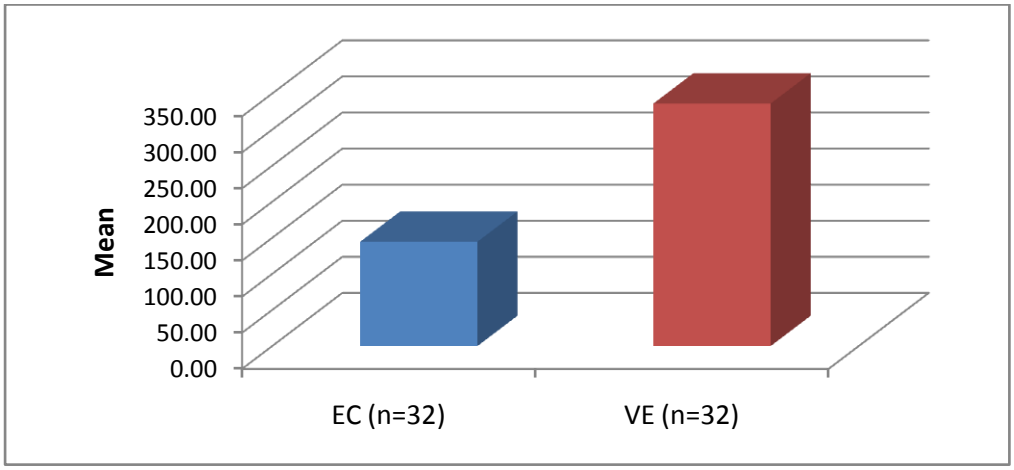


Figure-22. Mean Vte in patients who had failed BMV with E-C technique and were rescued with V-E technique in Group B

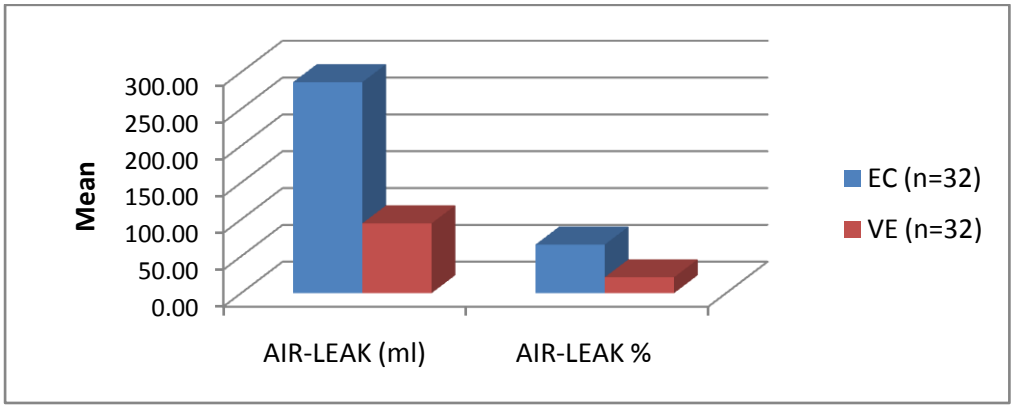


Figure-23. Mean air-leak in patients who had failed BMV with E-C technique and were rescued with V-E technique in Group B

Thus, in group B

- V-E technique effectively rescued patients who had failed ventilation with E-C technique.
- Only 3 patients failed ventilation with V-E technique and were not rescued with E-C technique either, leading to use of airway adjunct and termination of the study. It is very unlikely that E-C technique can act as rescue technique.
- Failure rate of E-C technique was 17.5% and 1.5% with V-E technique.

DISCUSSION

Bag mask ventilation (BMV) is an essential component of airway management for emergency medical service providers and anaesthesiologists in the operating room. This life saving technique allows for oxygenation and ventilation of patients until a more definitive airway can be established thereby preventing life-threatening consequences of hypoxia like cardiovascular collapse and irreversible brain injury.[1-3]

Despite the vital role of BMV in airway management it is often either inadequate or fraught with difficulties. Difficult mask ventilation (DMV) is a situation in which it is impossible for an unassisted anaesthesiologist to maintain oxygen saturation >90% using 100% inspired oxygen and positive pressure ventilation to prevent or reverse signs of inadequate ventilation.[5] Two main mechanisms contributing to DMV includes upper airway obstruction and air-leak at mask-face interface or to an alternative oesophagus-gastric path of least resistance.[26] Overcoming these difficulties by optimizing BMV techniques is crucial to airway management. Among the various techniques described for performing BMV, two-handed BMV techniques provides better seal and have proven to be more efficient at providing greater tidal volumes with lesser air-leak as compared to one-handed BMV techniques.[15] The two commonly used two-handed techniques of BMV are E-C clamp and V-E technique. Gerstein et al have reported an overall BMV skill equivalence with superiority of two-handed V-E technique over the C-E technique in terms of exhaled tidal volume (Vte), when performed by novice care providers in patients who were easy to ventilate.[14] Fei et al also established superiority of two-handed modified V-E technique over E-C technique in a study including unconscious apnoeic obese adults.[27] Though the comparative efficacy of these two techniques on a patient group with single predictor of DMV has been studied,[26,27] none of the studies have evaluated these two handed techniques in a population of subjects with variable predictors

of anticipated DMV. The predictors of DMV included in our study were BMI > 31 kg/m^2 (n=91), edentulous (n=53), snoring g (n=38), OSA (n=3), bearded (n=92), short thyromental distance (n=12), and MPS score III and IV (n=221 & 66). We also observed additional predictors of DMV in our patient population like male gender with age >51 years[10] (n=147), MO<2FB (n=1), NC≥40cm (n=6) and RE (n=6). Scientific studies have established positive correlation of DMV in presence of these predictors. [10,34,36,43,44] Khetarpal et al identified BMI ≥ 30 kg/m^2, presence of beard, MPS III or IV, age ≥ 57 yr, thyromental distance < 6 cm, severely limited jaw protrusion, and snoring as independent predictors of DMV.[10,45]

We therefore conducted a randomized, cross-over, prospective study in 400 patients with predictors of DMV and compared the efficacy of two-handed E-C clamp and two-handed V-E technique in terms of exhaled tidal volume (Vte), air leak, end tidal CO_2 ($EtCO_2$), minute ventilation (MV), peak inspiratory pressure (PIP), plateau pressure and oxygen saturation (SpO_2). The primary outcome analysed was exhaled tidal volume (Vte) which was significantly higher with the two-handed V-E technique [378.41 (SD 58.40) ml] as compared to two-handed E-C technique [303.09 (SD 103.45) ml] with a mean difference of 75.32 ml (p<0.001), irrespective of success or failure of the techniques (n=400). These results are comparable with the results of the study conducted by Gerstain et al who compared the traditional two-handed E-C clamp (EC) with two-handed thenar eminence (TE) technique.[14] In their study, the TE grip provided greater Vte (379 ml vs 269 ml), with a mean difference of 110 ml (p<0.001). The higher mean difference of 110 ml between the two techniques in their study could be attributed to performance of BMV by novice providers in patients who did not have any predictors of DMV in their study. The lesser degree of mean difference observed in our study despite presence of predictors of DMV could be ascribed to the expertise of operators. BMV in our study was performed by 11 operators with experience of at least more than 5 years.

Another study by Fei et al also compared the effectiveness of these two ventilation techniques on 81 unconscious apnoeic obese adults and observed superiority of modified two-handed V-E technique in generating higher Vte of 720 (SD 244) ml for the V-E technique in comparison to a Vte of 371 (SD 345) ml for the C-E technique ($p<0.001$) [27]. The higher tidal volumes generated in their study can be related to the use of pressure control mode of ventilation whilst we employed volume-controlled mode of ventilation which could have possibly led to lower Vte. The failure rates for mask ventilation reported in their study were higher for the C-E technique (44%) as compared to those found in our study (19.75%) probably because they assessed only obese patients unlike the patient population included in our study who had variable predictors of DMV. It is presumed that few of these predictors of DMV may have contributed to a lower incidence of failure in BMV. However, this assumption needs further investigation as a sub-analysis of each predictor was not feasible due to the non-uniform numbers of predictors among patients enrolled in our study. Our results are in contrast to the study conducted by Hart D et al comparing three techniques (one-hand C-E technique, two-hand C-E technique and two-hand V-E technique) of face mask ventilation. They obtained higher Vte with two-handed C-E technique (550.8 ml) as compared to the two-handed V-E technique (538 ml) ($p < 0.001$).[13] This variability may be attributed to the mannequin-based nature of the study and hence their results cannot be extrapolated to human subjects directly.

Among the secondary outcomes, we mainly focused on PIP and air-leak which were found to be significantly higher with E-C technique as compared to V-E technique. The overall PIP observed in our study was 15.48 (SD 2.95) cm H_2O for V-E & 16.16 (SD 4.29) cm H_2O for E-C technique which were in contrast to the study conducted by Gerstain et al [14] wherein no significant difference in PIP values using the two techniques was observed [TE=14.2 (SD 7.0) cm H_2O and EC=13.5 (SD 9.0) cm H_2O] ($p= 0.49$). The indirect correlation between Vte and airway pressure (higher Vte and lower airway pressures) obtained in

our study was missing in the study by Gerstain et al. The possible explanation for this can be attributed to the fact that apart from tidal volume, airway pressure depends on many other factors like airway resistance, respiratory system compliance, PEEP, type of interface used for ventilation, seal of the mask, use of muscle relaxant, operator characteristics like hand grip, and active breathing efforts of the patient, especially if no neuro-muscular blockade (NM Blockade) is administered.[14,46] Therefore possibly variable airway pressures are obtained in different scenarios. The higher mean PIP with TE grip as compared to EC technique reported by Gerstain et al[14] can be attributed to the absence of neuromuscular blockade.

The NM blockade used in our study assisted us to overcome the factors leading to increased airway obstruction such as laryngospasm, or opioid induced vocal cord closure etc. In addition, it offers an advantage of improving chest wall compliance and avoiding ventilator-patient dyssynchrony. Many trials also indicate that administration of NM Blockade may actually improve face mask ventilation.[47,48]

Also, the use of Volume Control mode of ventilation (VCV) and NM blockade allowed us to measure air-leak which was not evaluated by Fei et al. We observed a higher air-leak with E-C technique [133.21 (SD 103.87) ml] as compared to V-E technique [57.89 (SD 45.55) ml].The possible reason for this observed higher air-leak can be ascribed to the direct compression of the submandibular tissue caused by the placement of the operator's fingers on the front of the neck pushing the submandibular tissue posteriorly in the E-C technique.[27] Stephane X et al evaluated inadequate seal and air-leak during two handed BMV in 49 edentulous patients and concluded that the placement of mask in lower lip position markedly improved mask seal, and hence a reduced air-leak with improved ventilation.[26]

The use of two-handed V-E technique in our study improved the airway patency secondary to effective jaw thrust displacing the mandible anteriorly. Studies[27,49] have postulated that a positive pressure is

generated by V-E technique of mask ventilation which pushes the submandibular tissue furthermore anteriorly, thus relieving upper airway obstruction leading to delivery of higher tidal volume at lower pressures (peak inspiratory and plateau pressure). Also, the use of thenar eminence produces effective seal of the mask on the patient's face which further decreases the air-leak as compared to the E-C technique.[14,15]

We also observed higher MV, $EtCO_2$ with concomitant lower airway pressures with V-E technique as compared to E-C technique thereby proving the superiority of two-handed V-E technique over two-handed E-C technique of BMV.

Group analysis revealed that 161 patients could be successfully ventilated in Group A with the E-C technique, while 39 of them had failed BMV. After cross-over all patients including those who had a failed BMV with E-C technique, were successfully ventilated with the V-E technique. Thus, V-E technique served as a rescue for failed EC technique in these 39 patients.

In Group B, 200 subjects were first ventilated with the V-E technique and 197 of them were successfully ventilated while 3 of them had failed mask ventilation. After cross over to E-C technique 32 of 197 patients failed BMV and were later successfully rescued with V-E technique. The 3 patients who experienced failed BMV with the V-E technique also had failed BMV with the E-C technique and thus required an airway adjunct in form of an oro-pharyngeal airway as rescue. Hence, we inferred that the E-C technique could not rescue the failed V-E technique probably because of the presence of more than 3 predictors of DMV in these patients.

Overall, the failure rate with two-handed E-C technique was 19% and 1% with two-handed V-E technique. We also observed a higher percentage of patients experiencing failed BMV in the presence of ≥ 3 predictors of DMV. This indicates that patients with concomitant multiple predictors of DMV may need additional measures like airway

adjuncts or use of LMA for effective ventilation. Indeed, an oral/nasal airway was not used during performance of these two techniques in our study and thus, the effect of these adjuncts to further improve the efficacy of both techniques of BMV remains unpredicted amongst patients with predictors of DMV.

There were a few limitations in our study worth mentioning. Our study was not blinded which could have prompted the operator to improve his grips further during BMV. The results of our study cannot be translated directly to all unconscious patients who need BMV in the emergency department as we administered NM blockade to our study population in the controlled setting of operating rooms. As our study included experienced operators, we cannot predict if these results can be reproduced with novice operators using the same techniques.

In conclusion the two-handed V-E technique resulted in effective ventilation as compared to two-handed E-C technique in patients with predictors of difficult bag mask ventilation when performed by the trained and experienced operators. Two-handed V-E technique also proved to be an effective rescue strategy in cases where E-C technique failed. The failure rate of BMV with two-handed V-E technique was also lower. Therefore, two-handed V-E technique should be preferred as a first option in patients with anticipated DMV.

SUMMARY AND CONCLUSION

1. We compared the effectiveness of two-handed E-C clamp and two-handed V-E clamp techniques of BMV in a prospective, randomized, cross over study in 400 ASA I-III adult patients with DMV who were scheduled for elective and emergency surgery under general anaesthesia.
2. The predictors of DMV included in our study were BMI >31 kg/m^2 (n=91), edentulous (n=53), snoring (n=38), OSA (n=3), bearded (n=92), short thyromental distance (n=12), and MPS score III and IV (n=221 & 66). We also observed additional predictors of DMV in our patient population like male gender with age >51 years (n=147), MO<2FB (n=1), NC≥40cm (n=6) and RE (n=6).
3. Patients were enrolled and randomly allocated into two study groups of 200 patients each. Patients in group A were first ventilated with E-C technique and then crossed-over to V-E technique. In group B patients were first ventilated with V-E technique and then crossed-over to E-C technique.
4. Ventilator was pre-set to VCV mode to deliver a tidal volume of 7 ml/kg, 10 breaths per minute, and no positive end-expiratory pressure.
5. After induction of anaesthesia and when apnoea was observed BMV was performed by a trained anaesthesia consultant with an experience of more than 5 years in a cross-over manner. Neuromuscular blocker was also administered as part of anaesthesia induction.
6. Primary outcome analysed in our study was expired tidal volume (Vte) and secondary outcomes included end-tidal carbon dioxide ($EtCO_{2)}$, peak inspiratory pressure (PIP), air-leak, minute ventilation (MV), plateau pressure and SpO_2. The final analysis was done by calculating the mean of first five breaths in failed ventilation and mean of ten breaths in successful ventilation.

7. We observed a statistically significant higher mean Vte, MV, $EtCO_2$ with concomitant lower airway pressures & less air-leak with V-E technique as compared to E-C technique thereby validating superiority of two-handed V-E technique over two handed E-C technique of BMV.
8. Mean Vte of 377.83 (SD 58.43) ml with V-E technique was significantly higher as compared to 303.26 (SD 103.34) ml with C-E technique ($p<0.001$).
9. The air-leak was found to be significantly more with E-C technique [131.05 (SD 100.95) ml] as compared to V-E technique [59.08 (SD 49.62) ml] ($p<0.001$).
10. The higher air-leak observed with E-C technique can be attributed to the compression of submandibular tissue thereby decreasing the airway patency and increasing the resistance causing the air to leak along alternative pathways of least resistance.
11. Overall the failure rate with two handed E-C technique was 19% and 1% with two-handed V-E technique ($p<0.001$).
12. In group A:
    a. All subjects who failed mask ventilation with the E-C technique were ventilated effectively with the V-E technique.
    b. Failure rate with E-C technique was 20.5%
    c. No failure was observed with V-E technique.

    Hence, we can infer that V-E technique is an effective rescue for a failed E-C technique.
13. In group B:
    a. V-E technique effectively rescued the patients who have failed BMV with E-C technique.
    b. Only 3 patients who failed BMV with V-E technique were not rescued with E-C technique either, leading to use of airway adjunct and termination of the study. Thus, it is very unlikely that E-C technique can act as rescue technique.

c. Failure rate of E-C technique was17.5% and 1.5% with V-E technique.

14. We observed a higher percentage of patients experiencing failed BMV in the presence of ≥ 3 predictors of DMV.
15. It was concluded that two-handed V-E technique should be the preferred over two-handed E-C technique in cases of anticipated DMV.

BIBLIOGRAPHY

1. Ortega R, Mehio A, Woo A,Hafez D. Positive-Pressure Ventilation with a Face Mask and a Bag-Valve Device. N Engl J Med. 2007;357:e4.
2. Saddawi-Konefka D, Hung S, Kacmarek R, Jiang Y. Optimizing Mask Ventilation: Literature Review and Development of a Conceptual Framework. Respir Care. 2015;60:1834-40.
3. Bucher JT, Vashisht R, Ladd M, Cooper JS. Bag mask ventilation (bag valve mask, BVM). StatPearls [Internet]. 2020
4. Myatra SN, Shah A, Kundra P, Patwa A, Ramkumar V, Divatia JV, et al. All India Difficult Airway Association 2016 guidelines for the management of unanticipated difficult tracheal intubation in adults. Indian J Anaesth. 2016;6:885.
5. Hagberg C, Connis, R, Difficult Airway Society 2015 guidelines for the management of unanticipated difficult intubation in adults: not just another algorithm. Br J Anaesth. 2016;116:309.
6. Cheney FW, Posner KL, Lee LA, Caplan RA, Domino KB. Trends in anesthesia-related death and brain damage: a close claims analysis. Anesthesiology. 2006;105:1081-6.
7. Cattano D, Katsiampoura A, Corso RM, Killoran PV, Cai C, Hagberg CA. Predictive factors for difficult mask ventilation in the obese surgical population. 2014;3:F1000.
8. Sato S, Hasegawa M, Okuyama M, Okazaki J, Kitamura Y, Sato Y, et al. Mask Ventilation during Induction of General Anesthesia. Anesthesiology. 2017;126:28-38.
9. Gautam P, Gaul TK, Luthra N. Prediction of difficult mask ventilation. Eur J Anaesthesiol. 2005;22:638-40.
10. Kheterpal S, Healy D, Aziz M, Shanks A, Freundlich R, Linton F, et al. Incidence, Predictors, and Outcome of Difficult Mask Ventilation Combined with Difficult Laryngoscopy. Anesthesiology. 2013;119:1360-9.
11. Riad W, Vaez M, Raveendran R, Tam A, Quereshy F, Chung F, et al. Neck circumference as a predictor of difficult intubation

and difficult mask ventilation in morbidly obese patients. Eur J Anaesthesiol. 2016;33:244-9.

12. Cattano D, Killoran P, Cai C, Katsiampoura A, Corso R, Hagberg C. Difficult mask ventilation in general surgical population: observation of risk factors and predictors. F1000Res. 2014;3:204.
13. Hart D, Reardon R, Ward C, Miner J. Face mask ventilation: a comparison of three techniques. J Emerg Med. 2013;44:1028-33.
14. Gerstein NS, Carey MC, Braude DA. Efficacy of facemask ventilation techniques in novice providers. J Clin Anesth. 2013;25:193-7.
15. Joffe AM, Hetzel S, Liew EC. A two-handed jaw-thrust technique is superior to the one-handed “EC-clamp” technique for mask ventilation in the apneic unconscious person. Anesthesiology. 2010;113:873-9.
16. Davidovic L, LaCovey D, Pitetti RD. Comparison of 1- versus 2-person bag-valve-mask techniques for manikin ventilation of infants and children. Ann Emerg Med. 2005;46:37-42.
17. Brodksy B. Anaesthetic management of the morbidly obese patient Int Anesthesiol Clin. 1986; 24:93-103.
18. Douglas N, Polo O. Pathogenesis of obstructive sleep apnoea/ hypopnoea syndrome. Lancet. 1994;344:653-5
19. White DP, Lombard RM, Cadieux RJ, Zwillich CW: Pharyngeal resistance in normal humans: Influence of gender, age and obesity. J Appl Physiol. 1985;58:365-71
20. Wilson ME. Spiegelhalter 0, Robertson JA, Lesser P. Predicting difficult intubation. Br J Anaesth. 1988;61:211-6.
21. Khan ZH, Kashji A, Ebrahimkhani E. A Comparison of Upper lip bite test (A Simple new technique) with difficulty in endotracheal intubation; A Prospective Blinded study. Anesth Analg 2003;96:595-9
22. Mallampati SR, Gatt SP, Gugino LD, Desai SP, Waraksa B, Freiberger D, et al. A clinical sign to predict difficult tracheal

intubation; a prospective study. Can Anesth Soc J 1985;32:429-34.

23. Patil VU, Stehling LC, Zaunder HL. Fiberoptic Endoscopy in Anesthesia. Chicago: Year Book Med. Publishers; 1983.
24. Savva D. Prediction of difficult tracheal intubation. Br J Anaesth 1994;73:149-53.
25. Brodsky JB, Lemmens HJ, Brock-Utne JG, Vierra M, Saidman LJ. Morbid obesity and tracheal intubation. Anesth Analg 2002;94:732-6.
26. Racine SX, Solis A, Hamou NA, Letoumelin P, Hepner DL, Beloucif S, et al. Face Mask Ventilation in Edentulous Patients. Anesthesiology. 2010;112:1190-3.
27. Fei M, Blair JL, Rice MJ, Edwards DA, Liang Y, Pilla MA, et al. Comparison of effectiveness of two commonly used two-handed mask ventilation techniques on unconscious apnoeic obese adults. Br J Anaesth. 2017;118:618-24.
28. Benyamin RM, Wafai Y, Salem MR, Joseph NJ. Two-handed mask ventilation of the difficult airway by a single individual. Anesthesiology. 1998;88:1134.
29. Saddawi-Konefka D, Hung SL, Kacmarek RM, Jiang Y. Optimizing mask ventilation: literature review and development of a conceptual framework. Respir Care. 2015;60:1834-40.
30. Chopin C. L'histoire de la ventilation mécanique: des machines et des hommes. Réanimation. 2007;16:4-12.
31. Fahey DG. The self-inflating resuscitator–Evolution of an idea. Anaesth Intensive Care Med. 2010;38:10-5.
32. Khoury A, Hugonnot S, Cossus J, De Luca A, Desmettre T, Sall, F, et al. From Mouth-to-Mouth to Bag-Valve-Mask Ventilation: Evolution and Characteristics of Actual Devices—A Review of the Literature. BioMed Research International. 2014;p:1-6.
33. Kheterpal S, Han R, Tremper KK, Shanks A, Tait AR, O'Reilly M, et al. Incidence and predictors of difficult and impossible mask ventilation. Anesthesiology. 2006;105:885-91.

34. Langeron O, Masso E, Huraux C, Guggiari M, Bianchi A, Coriat P. et al. Prediction of difficult mask ventilation. Anesthesiology. 2000;92:1229–36.
35. Soleimanpour H, Sarahrudi K, Hadju S, Golzari SE. How to overcome difficult-bag-mask-ventilation: Recents approaches. Emerg Med. 2012;2:e116.
36. Han R, Tremper KK, Kheterpal S, O'Reilly M. Grading scale for mask ventilation. Anesthesiology. 2004;101:267.
37. Practice guidelines for management of the difficult airway: an updated report by the American Society of Anesthesiologists Task Force on Management of the Difficult Airway. Anesthesiology. 2003;98:1269–77.
38. Taxak S, Ghai A, Singh R, Kamal K. Edentulous patient and face mask ventilation. Indian J Anaesth. 2008;52:347–8.
39. Conlon NP, Sullivan RP, Herbison PG, Zacharias M, Buggy DJ. The effect of leaving dentures in place on bag – mask ventilation at induction of general anesthesia. Anesth Analg. 2007;105:370-3.
40. Golzari SE, Soleimanpour H, Mehryar H, Salarilak S, Mahmoodpoor A, Panahi JR, et al. Comparison of three methods in improving bag mask ventilation. Int J Prev Med. 2014;5:489.
41. Umessh G, Krishna R, Chaudhuri S, Tim TJ, Shwethapriya R. E-O technique is superior to E-C technique in manikins during single person bag mask ventilation performed by novices. J Clin Monit Comput. 2014;28:269–73.
42. Soleimanpour M, Rahmani F, Ala A, MortezaBagi H, Mahmoodpoor A, Golzari S, et al. Comparison of four techniques on facility of two-hand Bag-valve-mask (BVM) ventilation: E-C, Thenar Eminence, Thenar Eminence (Dominant hand)-E-C (non-dominant hand) and Thenar Eminence (non-dominant hand) – E-C (dominant hand). J Cardiovasc Thorac Res. 2016;8:147.

43. Benumof JL. Management of the difficult airway: With special emphasis on awake tracheal intubation. Anesthesiology. 1991;75:1087–10.
44. Caplan RA, Benumof JL, Berry FA, Blitt CD, Bode RH, Cheney FW, et al. Practice guidelines for management of the difficult airway: A report by the ASA Task Force on Management of the Difficult Airway. Anesthesiology. 1993; 78:597–602.
45. Shiga T, Wajima ZI, Inoue T, Sakamoto A. Predicting difficult intubation in apparently normal patients: a meta-analysis of bedside screening test performance. Anesthesiology. 2005;103:429-37.
46. Hess DR. Respiratory mechanics in mechanically ventilated patients. Resp Care. 2014;59:1773-94.
47. Joffe AM, Ramaiah R, Donahue E, Galgon RE, Thilen SR, Spiekerman CF, et al. Ventilation by mask before and after the administration of neuromuscular blockade: a pragmatic non-inferiority trial. BMC anesthesiology. 2015;15:1-9.
48. Ikeda A, Isono S, Sato Y, Yogo H, Sato J, Ishikawa T, et al. Effects of muscle relaxants on mask ventilation in anesthetized persons with normal upper airway anatomy. Anaesthesiology. 2012 Sep 1;117:487-93.
49. Sato Y, Ikeda A, Ishikawa T, Isono S. How can we improve mask ventilation in patients with obstructive sleep apnea during anesthesia induction? Journal of anesthesia. 2013;27:152-6.

Sr. No	Admission No	Date	Treatment Group	Patient's Demographics							Set Tidal Volume (7ml/kg of PBW)	Failure cut-off (4ml/kg of PBW)	V-E										E-C									
				Age	Gender	ASA	Weight	Predicted Body Weight	Height	BMI			Vte	Airleak	Airleak (%)	Vte/AW	Vte/PW	EtCO2	PIP	MV	Plateau	SpO2 (%)	Vte	Airleak	Airleak (%)	Vte/AW	Vte/PW	EtCO2	PIP	MV	Plateau
1	653801	1/21/2019	B	35	F	1	59	51.92	160	23.05	360.0	207.7	314.80	45.2	12.56	5.34	6.06	19.9	13.6	3.1	8.9	100	297.6	62.40	17.33	5.04	5.73	19.3	12.9	3.0	8.9
2	657132	1/22/2019	A	45	F	1	68	54.19	162.5	25.75	380.0	216.8	343.30	36.7	9.66	5.05	6.34	25.4	13	3.4	11.2	100	324.8	55.20	14.53	4.78	5.99	22.8	14.3	3.0	12
3	491185	2/4/2019	A	45	M	1	87	63.83	167.6	30.97	450.0	255.3	405.20	44.8	9.96	4.66	6.35	26.5	16.8	4.1	13.2	100	290.2	159.80	35.51	3.34	4.55	18.7	13	2.9	9.8
4	663372	2/4/2019	B	42	M	3	68	77.66	182.8	23.22	540.0	310.7	503.40	36.6	6.78	7.40	6.48	33.2	22.2	5.0	21.2	100	434.5	105.50	19.54	6.39	5.59	28	26.1	4.3	25.1
5	536548	2/18/2019	B	44	M	2	94	77.74	182.88	28.11	540.0	310.9	497.50	42.5	7.87	5.29	6.40	30.5	15.8	5.0	13.8	100	432	108.00	20.00	4.60	5.56	26.1	14.6	4.3	12.8
6	677962	2/28/2019	A	40	M	2	100	63.87	167.64	35.58	450.0	255.5	261.60	188.4	41.87	2.62	4.10	21.3	14.2	2.6	10.7	100%	119.4	330.60	73.47	1.19	1.87	7.4	4.2	1.2	2
7	678541	3/1/2019	B	63	F	1	70	54.19	162.5	20.52	380.0	216.8	352.70	27.3	7.18	5.04	6.51	28	14.0	3.5	13	100	202.5	177.50	46.71	2.89	3.74	26.2	23.2	2.0	22.2
8	669061	3/5/2019	B	39	M	1	86	63.87	167.64	31.60	450.0	255.5	407.60	42.4	9.42	4.74	6.38	25.3	13.7	4.1	9.6	100	333.1	116.90	25.98	3.87	5.22	21.7	11.8	3.3	8.8
9	682262	3/5/2019	A	51	F	1	77	51.92	160	30.08	360.0	207.7	335.60	24.4	6.78	4.36	6.46	25.3	12.4	3.4	11.5	100	283.3	76.70	21.31	3.68	5.46	21.2	15.4	2.8	14.7
10	681759	3/5/2019	B	59	M	2	87	70.80	175.26	28.32	500.0	283.2	452.60	47.4	9.48	5.20	6.39	31.8	18	4.5	16	100	388.5	111.50	22.30	4.47	5.49	27.1	18.9	3.9	16.8
11	682337	3/6/2019	A	60	F	2	61	47.28	154.9	25.42	330.0	189.1	301.10	28.9	8.76	4.94	6.37	20.4	12.6	3.0	11.7	100	284.3	45.70	13.85	4.66	6.01	20.6	14.7	2.8	13.4
12	682980	3/6/2019	B	59	M	1	98	56.92	160	38.28	400.0	227.7	336.30	63.7	15.93	3.43	5.91	26.1	14.5	3.4	13.5	100	295	105.00	26.25	3.01	5.18	22.2	16.5	3.0	15.4
13	620795	3/6/2019	B	52	M	1	80	72.39	177	25.54	510.0	289.5	342.90	167.1	32.76	4.29	4.74	33.5	13.5	3.4	12.5	100	285.3	224.70	44.06	3.57	3.94	27.4	14.6	2.8	13
14	467902	3/6/2019	A	56	M	1	75	66.18	170.18	25.90	460.0	264.7	418.30	41.7	9.07	5.58	6.32	15.4	19.4	5.0	18.4	100	364.8	95.20	20.70	4.86	5.51	31.2	10.1	3.6	9.1
15	682999	3/8/2019	A	27	M	1	70	63.83	167.6	22.72	450.0	255.3	400.70	49.3	10.96	5.72	6.28	18.8	15.8	4.0	14.8	100	349.5	100.50	22.33	4.99	5.48	15.1	18.1	3.5	17.1
16	685940	3/10/2019	A	46	M	1	85	70.75	175.2	23.05	500.0	283.0	463.90	36.1	7.22	5.46	6.56	19.6	11.5	4.6	10.5	100	313.6	186.40	37.28	3.69	4.43	14.5	17.4	3.3	16.4
17	365180	3/11/2019	A	74	M	1	69	72.39	177	22.02	510.0	289.5	336.30	173.7	34.06	4.87	4.65	31.3	12.7	3.4	11.5	100	194.2	315.80	61.92	2.81	2.68	19.4	14	1.9	12.6
18	686636	3/12/2019	B	39	M	2	88	61.47	165	32.32	430.0	245.9	321.90	108.1	25.14	3.66	5.24	32.3	16.6	3.2	15.6	100	142.6	287.40	66.84	1.62	2.32	9	14.8	1.4	12.6
19	685742	3/12/2019	A	51	F	2	101	51.92	160	39.45	360.0	207.7	292.9	67.1	18.64	2.90	5.64	29.2	14	2.9	14.8	100	0.00	360.00	100.00	0.00	0.00	0	0	0.0	0
20	514681	3/12/2019	A	62	F	2	53	47.73	155.4	21.95	330.0	190.9	295	35.0	10.61	5.57	6.18	29.7	13.3	3.0	11.8	100	336.30	-6.30	-1.91	6.35	7.05	31.8	18.3	3.4	16.8
21	683361	3/12/2019	A	24	M	1	74	66.18	170.18	22.85	460.0	264.7	415.80	44.2	9.61	5.62	6.28	19.4	18.4	4.2	17.4	100	365.9	94.10	20.46	4.94	5.53	13.9	14.9	3.7	13.9
22	292101	3/13/2019	B	53	M	3	106	70.80	175.26	34.51	500.0	283.2	201.4	298.6	59.72	1.90	2.84	22	15.2	2.0	13.2	100	0	500.00	100.00	0.00	0.00	0	4.6	0.0	4
23	669151	3/13/2019	A	29	M	1	85	66.18	170.18	29.35	460.0	264.7	365.5	94.5	20.54	4.30	5.52	35.1	16.9	3.7	15.7	100	426.40	33.60	7.30	5.02	6.44	33.8	20.6	4.3	18.2
24	687898	3/14/2019	B	45	M	1	68	59.19	162.5	25.75	410.0	236.8	316.9	93.1	22.71	4.66	5.35	31.1	15.6	3.2	13.8	100	374.20	35.80	8.73	5.50	6.32	35	15.6	3.7	13.8
25	681963	3/18/2019	A	45	M	1	85	68.47	172.7	28.50	480.0	273.9	397.2	82.8	17.25	4.67	5.80	32.2	16.9	4.0	14.9	100	422.80	57.20	11.92	4.97	6.17	31.8	22.8	4.2	19.9
26	645896	5/7/2019	B	58	F	2	70	56.56	165.1	25.68	400.0	226.2	365.40	34.6	8.65	5.22	6.46	35.1	20.6	3.7	19.1	100	352.5	47.50	11.88	5.04	6.23	32.3	17	3.5	16
27	664948	5/15/2019	A	51	M	2	88	68.47	172.7	29.51	480.0	273.9	437.80	42.2	8.79	4.98	6.39	34.4	21.3	4.4	18.3	100	374.1	105.90	22.06	4.25	5.46	30.4	16.7	3.7	13.7
28	516545	5/16/2019	B	31	M	2	89	66.18	170.18	30.73	460.0	264.7	423.60	36.4	7.91	4.76	6.40	30.9	20.8	4.2	18.3	100	423	37.00	8.04	4.75	6.39	31.6	18	4.2	15.1
29	730797	5/18/2019	A	56	M	2	80	66.11	170.1	27.65	460.0	264.4	400.10	59.9	13.02	5.00	6.05	29.2	20.8	4.0	18.7	100	283.7	176.30	38.33	3.55	4.29	25.3	14.8	3.2	13.8
30	731651	5/22/2019	B	75	M	2	86	66.20	170.2	29.69	460.0	264.8	430.00	30.0	6.52	5.00	6.50	31.8	18	4.3	16	100	363.8	96.20	20.91	4.23	5.50	27.1	18.9	3.6	16.8
31	719920	5/23/2019	B	42	F	2	93	51.92	160	36.33	360.0	207.7	333.70	26.3	7.31	3.59	6.43	26.2	15.4	3.3	13.4	100	243.4	116.60	32.39	2.62	4.69	21	14.8	2.3	13.3
32	702039	5/24/2019	B	51	F	3	72	56.56	165.1	26.41	400.0	226.2	366.00	34.0	8.50	5.08	6.47	28.8	17.6	3.7	15.6	100	352.5	47.50	11.88	4.90	6.23	28	15.2	3.5	14.1
33	682978	5/25/2019	A	38	F	2	68	56.56	165.1	20.75	400.0	226.2	358.80	41.2	10.30	5.28	6.34	21.8	14.8	3.6	13.8	100	314.8	85.20	21.30	4.63	5.57	26.7	14.7	3.1	13.7
34	684596	6/1/2019	B	65	F	1	59	49.55	157.4	23.81	350.0	198.2	302.7	47.3	13.51	5.13	6.11	22.7	16.7	3.0	14.9	100	118.40	231.60	66.17	2.01	2.39	9.6	11.4	1.2	10.4
35	667869	6/1/2019	B	52	M	3	70	61.56	165.1	25.68	430.0	246.2	383.90	46.1	10.72	5.48	6.24	28.2	15.9	3.8	14.2	100	378.4	51.60	12.00	5.41	6.15	27.4	17.9	3.8	15.2
36	726316	6/3/2019	B	75	M	3	59	63.83	167.6	21.00	450.0	255.3	359.50	90.5	20.11	6.09	5.63	27	16.2	3.6	14.3	100	353.9	96.10	21.36	6.00	5.54	25.7	19	3.5	17.1
37	730984	6/4/2019	A	42	M	2	82	80.03	185.4	23.86	560.0	320.1	488.80	71.2	12.71	5.96	6.11	35.3	19	4.9	16.7	100	454.2	105.80	18.89	5.54	5.68	34.3	21.1	4.5	19.1
38	179048	6/4/2019	A	42	M	2	75	59.19	162.5	28.40	410.0	236.8	377.20	32.8	8.00	5.03	6.37	31.7	17.5	3.8	16.2	100	330.4	79.60	19.41	4.41	5.58	30.5	18.1	3.3	16.2
39	740778	6/4/2019	B	60	F	2	67	47.73	155.4	27.74	330.0	190.9	336.30	-6.3	-1.91	5.02	7.05	32.4	16.6	3.4	15.4	100	295	35.00	10.61	4.40	6.18	29.4	16.7	3.0	14.7
40	744950	6/10/2019	B	37	M	2	94	75.43	180.34	28.90	530.0	301.7	399.80	130.2	24.57	4.25	5.30	34.8	17.8	4.0	15.8	100	419.9	110.10	20.77	4.47	5.57	34.4	20.3	4.2	18.3
41	746027	6/11/2019	B	21	M	2	88	63.83	167.6	31.33	450.0	255.3	336.30	113.7	25.27	3.82	5.27	32.6	16.9	3.4	15.4	100	335.2	114.80	25.51	3.81	5.25	31.6	18.5	3.3	16.2
42	743187	6/14/2019	A	31	M	2	89	70.75	175.2	28.99	500.0	283.0	337.00	163.0	32.60	3.79	4.76	34	17.0	3.4	15.6	100	295	205.00	41.00	3.31	4.17	29.8	17.6	3.0	15.5
43	748291	6/15/2019	B	56	F	1	72	47.73	155.4	29.81	330.0	190.9	340.00	-10.0	-3.03	4.72	7.12	33.6	16.9	3.4	14.9	100	303	27.00	8.18	4.21	6.35	30.5	17.6	3.0	15.7
44	750394	6/19/2019	A	46	M	1	85	75.12	180	26.23	530.0	300.5	336.30	193.7	36.55	3.96	4.48	32.6	17.5	3.4	15.5	100	291	239.00	45.09	3.42	3.87	28.4	17.8	3.0	15.5
45	713186	6/24/2019	B	33	M	2	70	75.43	180.34	21.52	530.0	301.7	487.80	42.2	7.96	6.97	6.47	34.9	20.1	4.9	18.1	100	413.9	116.10	21.91	5.91	5.49	31.9	21.2	4.1	19.3
46	62728	6/24/2019	B	55	M	2	85	68.47	172.7	28.50	480.0	273.9	437.60	42.4	8.83	5.15	6.39	31.1	14.1	4.4	12	100	421.3	58.70	12.23	4.96	6.15	30.4	15.8	4.2	13.9
47	752712	6/25/2019	B	74	M	2	80	66.11	170.1	27.65	460.0	264.4	419.20	40.8	8.87	5.24	6.34	31.9	17.9	4.2	15.3	100	368.3	91.70	19.93	4.60	5.57	27.7	18.5	3.7	16.4
48	747391	7/3/2019	B	65	M	1	58	70.80	175.26	23.05	500.0	283.2	449.80	50.2	10.04	7.76	6.35	26.1	25.1	4.5	24.1	100	300.5	199.50	39.90	5.18	4.24	21.3	13.3	3.1	12.3
49	759597	7/4/2019	A	71	M	1	67	70.80	175.26	23.05	500.0	283.2	456.10	43.9	8.78	6.81	6.44	24.6	14.6	4.6	13.6	100	388.7	111.30	22.26	5.80	5.49	23.2	22.2	3.9	21.2
50	761407	7/8/2019	B	31	F	1	88	56.56	165.1	20.75	400.0	226.2	365.10	34.9	8.72	4.15	6.46	18	13.0	3.7	12	100	320.2	79.80	19.95	3.64	5.66	15.8	18.7	3.2	17.7
51	732311	7/10/2019	B	59	M	2	59	70.75	175.2	23.05	500.0	283.0	455.60	44.4	8.88	7.72	6.44	21.8	12.8	4.6	11.8	100	320.2	179.80	35.96	5.43	4.53	16.4	20.4	4.0	19.4
52	755066	7/10/2019	A	68	M	2	70	70.80	175.26	23.05	500.0	283.2	456.10	43.9	8.78	6.52	6.44	17.9	14.9	4.6	13.9	100	328.6	171.40	34.28	4.69	4.64	13.6	19.6	3.3	18.6
53	763447	7/11/2019	B	56	M	2	58	66.18	170.18	22.85	460.0	264.7	427.70	32.3	7.02	7.37	6.46	19.1	21.1	4.3	20.1	100	364.2	95.80	20.83	6.28	5.50	18.5	20.5	3.6	19.5
54	84278	7/27/2019	B	31	M	1	100	84.67	190.5	27.56	590.0	338.7	537.60	52.4	8.88	5.38	6.35	34.2	15.9	5.4	13.7	100	535.9	54.10	9.17	5.36	6.33	33.7	18.4	4.6	16
55	393073	7/29/2019	B	76	F	2	75	58.83	167.6	26.70	410.0	235.3	375.20	34.8	8.49	5.00	6.38	33.7	15.6	3.8	13.7	100	295.5	114.50	27.93	3.94	5.02	30.5	16.1	3.0	14.6
56	774314	7/31/2019	B	42	M	2	62	63.83	167.6	22.07	450.0	255.3	415.90	34.1	7.58	6.71	6.52	32.5	19.5	4.2	17.5	100	400.2	49.80	11.07	6.45	6.27	31.9	16.6	4.0	14.7
57	774437	7/31/2019	B	51	M	2	100	68.47	172.7	33.53	480.0	273.9	375.50	104.5	21.77	3.76	5.48	28.3	15.7	3.8	13.9	100	221.80	258.20	53.79	2.22	3.24	23.8	15.2	2.5	13.2
58	527658	7/31/2019	B	51	F	2	72	51.92	160	28.13	360.0	207.7	328.80	31.2	8.67	4.57	6.33	28.7	17.3	3.3	15.2	100	314.1	45.90	12.75	4.36	6.05	30.2	14.5	3.1	12.6
59	674042	7/31/2019	A	41	F	2	68	54.19	162.5	25.70	480.0	216.8	348.40	131.6	27.42	5.12	6.43	33.5	18.4	3.5	15.6	100	343.5	136.50	28.44	5.05	6.34	33.4	15.3	3.0	13.7
60	774840	7/31/2019	A	52	F	3	92	75.39	160.02	34.80	530.0	301.6	435.45	94.6	17.84	4.73	5.78	19.2	18.3	4.1	17.3	100	348.6	181.40	34.23	3.79	4.62	17.7	20.1	3.5	19.2
61	759082	8/1/2019	A	47	M	2	80	68.47	172.7	26.82	480.0	273.9	430.90	49.1	10.23	5.39	6.29	32.9	16.6	4.3	14.6	100	440.4	39.60	8.25	5.51	6.43	32.6	20.6	3.7	16.9
62	778972	8/1/2019	B	75	M	2	70	54.55	157.4	28.25	380.0	218.2	353.60	26.4	6.95	5.05	6.48	30.4	14.6	3.5	12.8	100	287.6	92.40	24.32	4.11	5.27	26.5	15.5	2.9	13.3
63	779236	8/1/2019	A	60	M	1	54	73.11	177.8	17.08	510.0	292.5	336.30	173.7	34.06	6.23	4.60	33.7	14.6	3.4	13.4	100	295	215.00	42.16	5.46	4.03	28.5	15.8	3.0	13.9
64	774974	8/1/2019	B	54	M	1	79	73.11	177.8	24.99	510.0	292.5	336.30	173.7	34.06	4.26	4.60	33.6	14.7	3.4	13.2	100	349.4	160.60	31.49	4.42	4.78	29.4	14.7	3.0	12.1

Sr. No	Admission No		Failed E-C and rescue with V-E										Predictors of DMV										Operator Characteristics				
		SpO2	Vte	Airleak	Airleak	Vte/AW	Vte/PW	EtCO2	PIP	MV	Plateau	SpO2	Age >51yr	BM1>31	Snoring	OSA	Beard	Edentulous	TM Distance <6cm	MPS 3	MPS4	OTHERS	5-10 Yr	10-15yr	>15Yr	AGE	SEX
1	653801	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	-	Y	-	43	F
2	657132	100	-	-	-	-	-	-	-	-	-	-	N	N	Y	N	N	N	N	N	N	N	-	Y	-	42	F
3	491185	100	-	-	-	-	-	-	-	-	-	-	N	N	Y	N	N	N	N	N	Y	N	Y	-	-	38	M
4	663372	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	Y	N	N	N	N	N	-	Y	-	42	F
5	536548	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	N	Y	N	-	Y	-	44	F
6	677962	100	-	-	-	-	-	-	-	-	-	-	N	Y	N	N	N	N	N	N	Y	N	Y	-	-	38	M
7	678541	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	Y	N	N	N	N	-	Y	-	44	F
8	669061	100	-	-	-	-	-	-	-	-	-	-	N	Y	N	N	N	N	N	N	N	Y RE	-	Y	-	43	F
9	682262	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	-	Y	-	43	F
10	681759	100	-	-	-	-	-	-	-	-	-	-	Y	N	Y	N	N	N	N	Y	N	N	-	Y	-	42	F
11	682337	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	N	-	Y	-	44	F
12	682980	100	-	-	-	-	-	-	-	-	-	-	Y	Y	N	N	N	N	N	N	N	N	-	Y	-	44	F
13	620795	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	N	Y	N	-	Y	-	44	F
14	467902	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	N	Y	N	-	Y	-	44	F
15	682999	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	Y	Y	N	N	-	Y	-	44	F
16	685940	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	N	Y	N	-	Y	-	42	M
17	365180	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	Y	N	N	Y	N	-	Y	-	43	F
18	686636	100	291.25	138.8	32.27	3.31	4.74	30.4	15.4	3.0	14.4	100	N	Y	N	N	N	N	N	Y	N	N	-	-	Y	53	F
19	685742	100	-	-	-	-	-	-	-	-	-	-	N	Y	N	N	N	N	N	Y	N	N	Y	-	-	34	F
20	514681	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	Y	N	Y	N	N	-	Y	-	44	F
21	683361	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	-	-	Y	52	M
22	292101	100	291.50	208.5	41.70	2.75	4.12	23.9	17.4	2.9	16	100	Y	Y	N	N	Y	N	Y	N	Y	RE,> 51y	-	Y	-	42	F
23	669151	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	-	Y	-	43	F
24	687898	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	-	Y	-	42	F
25	681963	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	Y	-	-	33	F
26	645896	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	N	Y	-	-	38	F
27	664948	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	Y	-	-	38	F
28	516545	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	Y	-	-	38	F
29	730797	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	N	-	-	Y	52	M
30	731651	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	N	-	-	Y	52	M
31	719920	100	-	-	-	-	-	-	-	-	-	-	N	Y	N	N	N	N	N	Y	N	N	Y	-	-	38	F
32	702039	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	Y	-	-	38	F
33	682978	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	-	Y	-	42	F
34	684596	100	319.50	30.5	8.71	5.42	6.45	22.4	15.8	3.2	13.8	100	Y	N	N	N	N	Y	N	Y	N	N	Y	-	-	38	F
35	667869	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	N	-	-	Y	52	M
36	726316	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	N	Y	-	-	38	M
37	730984	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	CERVICAL COLLAR	-	Y	-	41	M
38	179048	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	Y	-	-	38	M
39	740778	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	N	-	Y	-	43	F
40	744950	100	-	-	-	-	-	-	-	-	-	-	N	N	N	Y	N	N	N	Y	N	N	-	Y	-	42	M
41	746027	100	-	-	-	-	-	-	-	-	-	-	N	Y	N	N	N	N	N	Y	N	N	Y	-	-	38	M
42	743187	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	-	Y	-	52	F
43	748291	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	N	-	Y	-	42	M
44	750394	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	Y	-	-	38	M
45	713186	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	Y	N	N	Y	N	N	-	-	Y	52	F
46	62728	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	Y	N	N	Y	N	N	-	Y	-	43	F
47	752712	100	-	-	-	-	-	-	-	-	-	-	Y	N	Y	N	N	Y	N	N	N	N	-	Y	-	41	F
48	747391	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	Y	N	N	N	N	-	Y	-	43	F
49	759597	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	Y	N	N	N	N	N	-	Y	-	42	F
50	761407	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	N	N	NC>40	-	Y	-	43	F
51	732311	100	-	-	-	-	-	-	-	-	-	-	Y	N	Y	N	N	N	N	N	Y	N	-	Y	-	42	F
52	755066	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	N	-	Y	-	44	F
53	763447	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	Y	N	N	N	N	-	Y	-	42	F
54	84278	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	-	Y	-	41	M
55	393073	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	Y	N	Y	N	N	-	Y	-	42	F
56	774314	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	Y	N	N	Y	N	N	-	Y	-	42	F
57	774437	100	388	92.0	19.17	3.88	5.67	27.8	15.6	3.7	14	100	N	Y	N	N	N	N	N	N	Y	N	-	Y	-	42	F
58	527658	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	-	Y	-	43	F
59	674042	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	Y	-	-	33	F
60	774840	100	-	-	-	-	-	-	-	-	-	-	Y	Y	N	N	N	N	N	Y	N	NC>40	-	Y	-	44	F
61	759082	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	Y	-	-	38	F
62	778972	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	Y	N	Y	N	N	-	-	Y	52	F
63	779236	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	N	-	Y	-	42	F
64	774974	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	Y	N	N	N	N	N	-	Y	-	42	F

Sr. No	Admission No	Date	Treatment Group	Patient's Demographics							Set Tidal Volume (7ml/kg of PBW)	Failure cut-off (4ml/kg of PBW)	V-E										E-C								
				Age	Gender	ASA	Weight	Predicted Body Weight	Height	BMI			Vte	Airleak	Airleak (%)	Vte/AW	Vte/PW	EtCO2	PIP	MV	Plateau	SpO2 (%)	Vte	Airleak	Airleak (%)	Vte/AW	Vte/PW	EtCO2	PIP	MV	Plateau
65	388509	8/2/2019	B	38	F	2	92	56.56	165.1	33.75	400.0	226.2	372.00	28.0	7.00	4.04	6.58	35.3	14.7	3.7	12.7	100	300.6	99.40	24.85	3.27	5.31	30.6	15.5	3.0	14.4
66	779175	8/2/2019	B	42	M	2	78	74.21	179	24.34	520.0	296.8	459.70	60.3	11.60	5.89	6.19	34.5	15.9	4.7	13.9	100	409.2	110.80	21.31	5.25	5.51	32.2	17.7	4.1	15.7
67	581227	8/2/2019	A	27	M	2	107	61.56	165.1	39.25	430.0	246.2	397.40	32.6	7.58	3.71	6.46	36.6	16.4	4.0	14.5	100	341.8	88.20	20.51	3.19	5.55	32.7	18.1	3.4	15.4
68	773760	8/2/2019	B	42	M	2	42	54.55	157.4	16.95	380.0	218.2	354.40	25.6	6.74	8.44	6.50	29.9	18.2	3.5	15.7	100	292.1	87.90	23.13	6.95	5.35	26.8	14.5	2.9	12.4
69	791234	8/2/2019	B	71	F	2	70	49.55	157.4	28.25	350.0	198.2	316.50	33.5	9.57	4.52	6.39	24	13.1	3.2	11	100	353.4	-3.40	-0.97	5.05	7.13	23.9	14.5	3.5	12.3
70	778734	8/2/2019	A	61	F	1	60	54.19	162.5	22.72	380.0	216.8	336.30	43.7	11.50	5.61	6.21	31.9	17.6	3.4	15.5	100	295	85.00	22.37	4.92	5.44	28.5	13.4	3.0	11.6
71	769835	8/2/2019	B	71	F	2	65	42.82	150	19.03	300.0	171.3	276.90	23.1	7.70	4.26	6.47	14.7	15.7	2.8	14.7	100	177.2	122.80	40.93	2.73	4.14	15.7	21.2	1.7	20.2
72	776874	8/3/2019	B	41	M	2	77	68.47	172.7	25.82	480.0	273.9	440.70	39.3	8.19	5.72	6.44	33.5	18.0	4.4	15.5	100	385.2	94.80	19.75	5.00	5.63	27.9	15.2	3.9	13.7
73	779977	8/3/2019	A	31	M	2	88	70.57	175	28.73	490.0	282.3	449.40	40.6	8.29	5.11	6.37	33.7	16.1	4.5	14.2	100	381.2	108.80	22.20	4.33	5.40	29.2	17.2	3.8	14.4
74	333860	8/3/2019	A	28	M	2	88	57.46	160.6	34.12	400.0	229.8	370.20	29.8	7.45	4.21	6.44	30.9	15.2	3.7	13.1	100	313.8	86.20	21.55	3.57	5.46	27.9	16.2	3.1	13.9
75	779240	8/3/2019	A	58	M	2	75	77.74	182.88	22.42	540.0	310.9	499.10	40.9	7.57	6.65	6.42	36.5	16.8	5.0	15	100	421.7	118.30	21.91	5.62	5.42	34.1	19.4	4.2	16.7
76	765806	8/3/2019	B	72	F	2	78	49.55	157.4	31.48	350.0	198.2	311.89	38.1	10.89	4.00	6.29	31.4	13.2	3.1	12.4	100	164.2	185.80	53.09	2.11	3.31	13.6	11.8	1.7	11
77	781066	8/5/2019	A	30	F	3	84	51.92	160	32.81	360.0	207.7	331.00	29.0	8.06	3.94	6.38	29.7	15.3	3.3	13.7	100	254.8	105.20	29.22	3.03	4.91	24.9	15.7	2.5	13.8
78	749095	8/5/2019	B	70	M	1	91	73.11	177.8	28.79	510.0	292.5	459.70	50.3	9.86	5.05	6.29	34.5	15.9	4.6	13.7	100	266	244.00	47.84	2.92	3.64	25.4	14.4	2.8	12.2
79	732486	8/5/2019	A	30	F	2	80	47.73	155.4	33.13	330.0	190.9	336.1	-6.1	-1.85	4.20	7.04	32.4	13.6	3.4	11.4	100	336.30	-6.30	-1.91	4.20	7.05	32.3	17.6	3.4	14.8
80	690426	8/6/2019	B	60	M	2	96	82.31	187.9	27.19	580.0	329.2	458.8	121.2	20.90	4.78	5.57	35.5	15.3	4.6	13.4	100	414.70	165.30	28.50	4.32	5.04	33.8	18.2	4.1	15.3
81	372106	8/6/2019	A	46	F	1	80	51.92	160	31.25	360.0	207.7	331.40	28.6	7.94	4.14	6.38	32	15.3	3.3	13.8	100	284.9	75.10	20.86	3.56	5.49	26.9	15.8	2.8	12.8
82	782166	8/6/2019	A	49	F	2	80	51.92	160	31.25	360.0	207.7	335.60	24.4	6.78	4.20	6.46	31.6	16.5	3.4	14	100	284.8	75.20	20.89	3.56	5.49	28.5	17.2	2.8	14.9
83	773506	8/6/2019	B	73	M	2	56	59.19	162.5	21.21	410.0	236.8	380.00	30.0	7.32	6.79	6.42	34.7	17.3	3.8	14.9	100	322.4	87.60	21.37	5.76	5.45	31.7	13.6	3.2	11.9
84	782048	8/6/2019	B	45	F	2	80	45.00	152.4	34.44	320.0	180.0	287.80	32.2	10.06	3.60	6.40	27.9	13.6	2.9	12	100	249.5	70.50	22.03	3.12	5.54	25.2	14.7	2.5	13.5
85	755146	8/7/2019	A	31	M	2	80	68.47	172.7	26.82	480.0	273.9	439.30	40.7	8.48	5.49	6.42	35.7	17.0	4.4	15.2	100	379.6	100.40	20.92	4.75	5.54	33.6	19.4	3.8	16.5
86	783155	8/7/2019	B	40	M	2	88	61.56	165.1	32.28	430.0	246.2	388.80	41.2	9.58	4.42	6.32	31.8	15.4	3.9	13.5	100	346.4	83.60	19.44	3.94	5.63	29.8	18.4	3.5	16.4
87	679265	8/7/2019	A	53	M	2	91	82.36	187.96	25.76	580.0	329.4	426.90	153.1	26.40	4.69	5.18	32.5	15.4	4.3	13.9	100	360.5	219.50	37.84	3.96	4.38	29.6	17.9	3.6	16
88	782905	8/7/2019	B	57	M	2	58	61.56	165.1	21.28	430.0	246.2	397.40	32.6	7.58	6.85	6.46	33.2	15.5	4.0	13.2	100	336.7	93.30	21.70	5.81	5.47	31.1	16.1	3.4	14.3
89	782590	8/7/2019	A	47	F	2	82	56.56	165.1	30.08	400.0	226.2	357.00	43.0	10.75	4.35	6.31	34.6	12.9	3.6	11.5	100	321.7	78.30	19.58	3.92	5.69	31.3	15.1	3.2	13.1
90	781543	8/7/2019	A	33	F	2	76	51.92	160	29.69	360.0	207.7	336.30	23.7	6.58	4.43	6.48	32.3	16.8	3.4	14.5	100	295	65.00	18.06	3.88	5.68	29.6	12.4	3.0	10.8
91	782906	8/7/2019	A	57	M	2	58	61.47	165	21.30	430.0	245.9	336.30	93.7	21.79	5.80	5.47	27.4	14.3	3.4	12.3	100	308.1	121.90	28.35	5.31	5.01	25.1	15.1	3.0	13
92	783820	8/8/2019	A	28	F	2	61	51.92	160	23.83	360.0	207.7	328.10	31.9	8.86	5.38	6.32	33.5	13.3	3.3	12.1	100	321.3	38.70	10.75	5.27	6.19	32.1	16.2	3.2	13.9
93	783812	8/8/2019	A	66	M	2	85	66.18	170.18	29.35	460.0	264.7	329.70	130.3	28.33	3.88	4.98	31.8	14.4	3.3	13.1	100	0	460.00	100.00	0.00	0.00	0	5	0.0	5
94	274370	8/8/2019	A	37	M	1	83	66.11	170.1	28.69	460.0	264.4	426.70	33.3	7.24	5.14	6.45	34.5	15.0	4.3	12.4	100	307.8	152.20	33.09	3.71	4.66	30.2	16.5	3.1	14.5
95	781162	8/8/2019	A	65	M	2	80	66.11	170.1	27.65	460.0	264.4	418.10	41.9	9.11	5.23	6.32	37	15.6	4.2	13.1	100	368.8	91.20	19.83	4.61	5.58	32.8	16.8	3.7	14.4
96	783769	8/8/2019	B	45	F	1	87	51.92	160	33.98	360.0	207.7	336.30	23.7	6.58	3.87	6.48	31.9	14.8	3.4	12.5	100	224	136.00	37.78	2.57	4.31	24	15.7	2.2	14.3
97	781951	8/9/2019	A	56	M	2	86	77.74	182.88	25.71	540.0	310.9	504.70	35.3	6.54	5.87	6.49	37.7	21.9	5.0	18.9	100	419	121.00	22.41	4.87	5.39	36.3	17	4.2	14.5
98	69192	8/9/2019	B	50	M	1	59	63.83	167.6	21.00	450.0	255.3	412.10	37.9	8.42	6.98	6.46	31	16.9	4.1	14.6	100	340.9	109.10	24.24	5.78	5.34	29.3	17.7	3.4	15.6
99	782174	8/9/2019	A	45	M	2	78	68.47	172.7	26.15	480.0	273.9	440.50	39.5	8.23	5.65	6.43	35.5	14.8	4.4	12.8	100	386.6	93.40	19.46	4.96	5.65	32.9	18.7	3.9	15.9
100	784567	8/9/2019	A	80	F	2	76	51.92	160	29.69	360.0	207.7	336.30	23.7	6.58	4.43	6.48	32.2	12.6	3.4	10.7	100	295	65.00	18.06	3.88	5.68	29.8	13.4	3.0	11.3
101	786142	8/12/2019	A	25	M	2	83	66.11	170.1	28.69	460.0	264.4	408.2	51.8	11.26	4.92	6.17	31.9	14.2	4.1	12.5	100	415.10	44.90	9.76	5.00	6.28	31.9	17.9	4.2	15.6
102	784995	8/12/2019	B	75	M	2	78	59.19	162.5	29.54	410.0	236.8	378.50	31.5	7.68	4.85	6.39	33.3	15.1	3.8	13.3	100	312.2	97.80	23.85	4.00	5.27	30.4	15.5	3.1	13.4
103	786479	8/12/2019	A	62	M	2	92	66.11	170.1	31.80	460.0	264.4	331.20	128.8	28.00	3.60	5.01	30.7	11.7	3.3	9.7	100	0	460.00	100.00	0.00	0.00	0	5.2	0.0	4.2
104	765566	8/12/2019	B	61	M	2	80	73.11	177.8	25.31	510.0	292.5	461.20	48.8	9.57	5.77	6.31	35.4	20.8	4.6	18.3	100	407.6	102.40	20.08	5.10	5.57	33.2	18	4.1	16
105	184490	8/12/2019	A	46	M	2	48	70.80	175.26	15.63	500.0	283.2	455.80	44.2	8.84	9.50	6.44	35.9	17.3	4.6	15.4	100	383.8	116.20	23.24	8.00	5.42	34.3	19.7	3.8	16.3
106	785747	8/12/2019	B	44	M	2	63	56.92	160	24.61	400.0	227.7	366.70	33.3	8.33	5.82	6.44	32.8	18.5	3.7	16.6	100	317.4	82.60	20.65	5.04	5.58	30.7	15	3.2	12.4
107	753206	8/12/2019	A	60	F	2	60	54.19	162.5	22.72	380.0	216.8	346.40	33.6	8.84	5.77	6.39	31.3	14.8	3.5	12.7	100	296.9	83.10	21.87	4.95	5.48	29.9	17.2	3.0	14.8
108	194212	8/13/2019	B	58	M	2	93	63.83	167.6	33.11	450.0	255.3	317.70	132.3	29.40	3.42	4.98	26.2	14.2	3.1	12.1	100	159.4	290.60	64.58	1.71	2.50	14.6	9.6	1.6	8.6
109	770590	8/13/2019	A	65	F	1	80	63.65	167.4	28.55	450.0	254.6	338.40	111.6	24.80	4.23	5.32	25.9	14.5	3.4	13	100	0.00	450.00	100.00	0.00	0.00	0	7.2	0.0	4.6
110	787145	8/13/2019	B	69	M	2	75	66.11	170.1	25.92	460.0	264.4	418.40	41.6	9.04	5.58	6.33	30.3	25.0	4.2	12.5	100	365.8	94.20	20.48	4.88	5.53	27.4	14.8	3.7	12.9
111	747171	8/13/2019	A	42	M	2	80	66.11	170.1	27.65	460.0	264.4	419.50	40.5	8.80	5.24	6.35	31.2	14.4	4.2	12.4	100	378.3	81.70	17.76	4.73	5.72	29.6	17.7	3.8	15.5
112	787046	8/13/2019	A	71	M	1	80	68.47	172.7	26.82	480.0	273.9	433.70	46.3	9.65	5.42	6.33	32.8	19.7	4.3	16.5	100	368.5	111.50	23.23	4.61	5.38	28.8	15.7	3.7	13.9
113	786048	8/13/2019	B	65	M	2	120	75.43	180.34	36.90	530.0	301.7	393.6	136.4	25.74	3.28	5.22	34	15	3.9	12.5	100	268.00	262.00	49.43	2.23	3.55	24	15.4	2.7	13.4
114	781820	8/14/2019	A	63	M	1	80	74.21	179	24.97	520.0	296.8	488.50	31.5	6.06	6.11	6.58	37.3	17.5	4.9	15.3	100	413.9	106.10	20.40	5.17	5.58	35.3	21	4.1	18.9
115	25525	8/14/2019	A	56	M	1	52	70.80	175.26	16.93	500.0	283.2	454.60	45.4	9.08	8.74	6.42	33.7	17.5	4.5	16.5	100	381.3	118.70	23.74	7.33	5.39	22.7	14.9	3.8	12.4
116	785861	8/14/2019	B	61	F	1	61	51.92	160	23.83	360.0	207.7	340.40	19.6	5.44	5.58	6.56	27.7	14.9	3.4	13.9	100	316.3	43.70	12.14	5.19	6.09	26	13.4	3.1	12.2
117	785861	8/14/2019	A	61	F	1	61	51.92	160	20.28	360.0	207.7	333.60	26.4	7.33	5.47	6.43	22.8	14.8	3.3	13.8	100	279.5	80.50	22.36	4.58	5.38	24.6	14.6	2.8	13.6
118	788092	8/19/2019	B	64	F	2	80	51.92	160	31.25	360.0	207.7	234.50	125.5	34.86	2.93	4.52	24.4	13.8	2.3	13	100	110.4	249.60	69.33	1.38	2.13	11.8	10	1.1	10.4
119	763215	8/20/2019	B	60	F	2	70	45.00	152.4	30.14	320.0	180.0	281.2	38.8	12.13	4.02	6.25	27.1	15.2	2.8	13.7	100	282.60	37.40	11.69	4.04	6.28	27.7	15.4	2.8	14.4
120	98476	8/20/2019	A	47	F	2	84	49.55	157.4	33.91	350.0	198.2	317.70	32.3	9.23	3.78	6.41	25.7	16.3	3.2	14.5	100	214.6	135.40	38.69	2.55	4.33	20.9	13	2.1	10.8
121	790156	8/22/2019	B	44	M	1	72	61.56	165.1	26.41	430.0	246.2	389.60	40.4	9.40	5.41	6.33	25.8	16.2	3.9	12.6	100	330.9	99.10	23.05	4.60	5.38	21.7	12.5	3.3	9.8
122	773925	8/27/2019	A	62	M	2	75	80.05	185.42	21.81	560.0	320.2	516.00	44.0	7.86	6.88	6.45	30.6	16.6	5.2	13.2	100	438.9	121.10	21.63	5.85	5.48	27.1	14.2	4.4	11.1
123	795997	8/27/2019	B	62	M	2	74	75.43	180.34	22.75	530.0	301.7	481.20	48.8	9.21	6.50	6.38	31.5	16.2	4.8	13.5	100	413.7	116.30	21.94	5.59	5.48	28.3	14.8	4.1	12
124	795997	8/27/2019	B	62	M	1	74	75.43	180.34	23.19	530.0	301.7	485.00	45.0	8.49	6.55	6.43	22.7	11.7	4.9	10.7	100	407.7	122.30	23.08	5.51	5.41	19.1	17.1	4.1	16.1
125	796913	8/28/2019	B	29	M	2	78	68.47	172.7	26.15	480.0	273.9	431.90	48.1	10.02	5.54	6.31	30.1	14.4	4.3	12.3	100	431.2	48.80	10.17	5.53	6.30	29.9	16.4	3.6	14.5
126	741996	8/28/2019	B	35	M	1	97	66.02	170	33.56	460.0	264.1	336.30	123.7	26.89	3.47	5.09	26.2	12.2	3.4	11.4	100	295	165.00	35.87	3.04	4.47	22.6	11.5	3.0	10
127	797991	8/29/2019	A	40	M	3	124	63.83	167.6	44.14	450.0	255.3	361.3	88.7	19.71	2.91	5.66	26.6	14.7	3.6	12.6	100	211.40	238.60	53.02	1.70	3.31	20.6	12	2.1	11
128	554484	8/30/2019	B	61	M	1	92	63.83	167.6	32.75	450.0	255.3	201.80	248.2	55.16	2.19	3.16	14.2	14.3	2.0	12.6	100	0	450.00	100.00	0.00	0.00	0	7	0.0	7

Sr. No	Admission No		Failed E-C and rescue with V-E										Predictors of DMV										Operator Characteristics				
		SpO2	Vte	Airleak	Airleak	Vte/AW	Vte/PW	EtCO2	PIP	MV	Plateau	SpO2	Age >51yr	BM1>31	Snoring	OSA	Beard	Edentulous	TM Distance <6cm	MPS 3	MPS4	OTHERS	5-10 Yr	10-15yr	>15Yr	AGE	SEX
65	388509	100	-	-	-	-	-	-	-	-	-	-	N	Y	N	N	N	N	N	Y	N	N	-	Y	-	43	F
66	779175	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	Y	N	N	N	N	N	-	-	Y	52	M
67	581227	100	-	-	-	-	-	-	-	-	-	-	N	Y	N	N	N	N	N	Y	N	N	Y	-	-	33	F
68	773760	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	-	Y	-	42	F
69	791234	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	N	-	Y	-	44	F
70	778734	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	N	-	Y	-	43	F
71	769835	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	Y	N	Y	N	N	-	-	Y	52	M
72	776874	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	-	Y	-	43	F
73	779977	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	Y	-	-	39	F
74	333860	100	-	-	-	-	-	-	-	-	-	-	N	Y	N	N	Y	N	N	N	N	N	-	-	Y	52	M
75	779240	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	Y	N	N	Y	N	N	-	-	Y	50	F
76	765806	100	277.5	72.5	20.71	3.56	5.60	29.6	13.4	2.8	11.6	100	Y	Y	N	N	N	Y	N	Y	N	N	-	Y	-	43	F
77	781066	100	-	-	-	-	-	-	-	-	-	-	N	Y	N	N	N	N	N	N	N	N	-	Y	-	44	F
78	749095	100	450.00	60.0	11.76	4.95	6.15	34.4	15.8	4.5	14	100	Y	N	N	N	Y	N	N	Y	N	N	-	Y	-	39	F
79	732486	100	-	-	-	-	-	-	-	-	-	-	N	Y	N	N	N	N	N	Y	N	N	-	-	Y	50	F
80	690426	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	N	-	-	Y	53	F
81	372106	100	-	-	-	-	-	-	-	-	-	-	N	Y	N	N	N	N	N	Y	N	N	-	Y	-	43	F
82	782166	100	-	-	-	-	-	-	-	-	-	-	N	Y	N	N	N	N	N	Y	N	N	-	Y	-	44	F
83	773506	100	-	-	-	-	-	-	-	-	-	-	Y	N	Y	N	N	Y	N	N	N	N	-	-	Y	52	M
84	782048	100	-	-	-	-	-	-	-	-	-	-	N	Y	Y	N	N	N	Y	Y	N	N	-	Y	-	43	F
85	755146	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	-	Y	-	44	F
86	783155	100	-	-	-	-	-	-	-	-	-	-	N	Y	Y	N	N	N	N	N	N	N	-	Y	-	42	M
87	679265	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	Y	N	N	Y	N	N	-	Y	-	44	F
88	782905	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	Y	N	N	N	N	N	-	Y	-	44	F
89	782590	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	-	Y	-	43	F
90	781543	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	-	Y	-	44	F
91	782906	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	Y	N	N	Y	N	N	-	Y	-	44	M
92	783820	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	-	Y	-	44	M
93	783812	100	-	-	-	-	-	-	-	-	-	-	Y	N	Y	N	N	Y	N	N	N	N	-	Y	-	44	F
94	274370	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	Y	N	N	Y	N	N	-	Y	-	44	F
95	781162	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	N	Y	N	-	-	Y	52	F
96	783769	100	-	-	-	-	-	-	-	-	-	-	N	Y	N	N	N	N	N	Y	N	N	-	Y	-	39	F
97	781951	100	-	-	-	-	-	-	-	-	-	-	Y	N	Y	N	Y	N	N	N	N	N	-	Y	-	43	F
98	69192	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	Y	N	N	N	N	N	Y	-	-	34	F
99	782174	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	Y	N	N	Y	N	N	Y	-	-	34	F
100	784567	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	N	-	Y	-	44	F
101	786142	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	Y	N	N	N	N	N	-	Y	-	44	F
102	784995	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	Y	N	N	N	Y	N	-	Y	-	44	F
103	786479	100	-	-	-	-	-	-	-	-	-	-	Y	Y	N	N	N	N	N	Y	N	N	-	Y	-	42	M
104	765566	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	N	-	Y	-	42	F
105	184490	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	-	Y	-	42	F
106	785747	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	Y	-	-	38	F
107	753206	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	N	-	Y	-	42	F
108	194212	100	351.75	98.3	21.83	3.78	5.51	26.4	14.4	3.5	12.4	100	Y	Y	N	N	N	N	N	Y	N	N	Y	-	-	34	F
109	770590	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	Y	N	N	N	N	-	Y	-	42	M
110	787145	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	N	-	Y	-	44	M
111	747171	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	Y	N	N	N	N	N	Y	-	-	38	M
112	787046	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	N	-	Y	-	44	F
113	786048	100	393.8	136.2	25.70	3.28	5.22	34	14.8	3.9	12.4	100	Y	N	N	N	Y	Y	N	Y	N	N	-	Y	-	44	M
114	781820	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	Y	N	N	N	N	N	-	Y	-	44	F
115	25525	100	-	-	-	-	-	-	-	-	-	-	Y	N	Y	N	Y	N	N	N	N	N	Y	-	-	34	F
116	785861	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	N	Y	N	-	Y	-	44	F
117	785861	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	N	Y	N	-	Y	-	42	F
118	788092	100	208	152.0	42.22	2.60	4.01	21.4	12.4	2.1	11.8	100	Y	Y	N	N	N	Y	N	N	N	N	-	-	Y	52	M
119	763215	100	-	-	-	-	-	-	-	-	-	-	Y	N	Y	N	N	N	N	N	N	Y	-	Y	-	44	F
120	98476	100	-	-	-	-	-	-	-	-	-	-	N	Y	N	N	N	N	N	N	Y	N	-	Y	-	39	F
121	790156	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	N	Y	N	-	Y	-	44	F
122	773925	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	Y	N	N	N	N	N	-	Y	-	42	M
123	795997	100	-	-	-	-	-	-	-	-	-	-	Y	N	Y	N	N	Y	N	N	N	N	-	Y	-	43	F
124	795997	100	-	-	-	-	-	-	-	-	-	-	Y	N	Y	N	N	N	N	Y	N	N	-	Y	-	42	F
125	796913	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	N	Y	RE	-	Y	-	43	F
126	741996	100	-	-	-	-	-	-	-	-	-	-	N	Y	N	N	N	N	N	N	Y	N	-	Y	-	44	F
127	797991	100	-	-	-	-	-	-	-	-	-	-	N	Y	Y	N	N	N	N	N	Y	N	-	Y	-	43	F
128	554484	100	178.5	271.5	60.33	1.94	2.80	14.8	13.8	1.7	11.8	100	Y	Y	N	N	Y	N	N	Y	N	N	Y	-	-	34	F

Sr. No	Admission No	Date	Treatment Group	Patient's Demographics							Set Tidal Volume (7ml/kg of PBW)	Failure cut-off (4ml/kg of PBW)	V-E										E-C								
				Age	Gender	ASA	Weight	Predicted Body Weight	Height	BMI			Vte	Airleak	Airleak (%)	Vte/AW	Vte/PW	EtCO2	PIP	MV	Plateau	SpO2 (%)	Vte	Airleak	Airleak (%)	Vte/AW	Vte/PW	EtCO2	PIP	MV	Plateau
129	794273	9/4/2019	B	66	M	2	90	70.75	175.2	29.32	500.0	283.0	336.30	163.7	32.74	3.74	4.75	26.6	15.1	3.4	13.6	100	295	205.00	41.00	3.28	4.17	23.1	11.4	3.0	9.8
130	793540	9/13/2019	B	40	F	2	80	51.92	160	31.25	360.0	207.7	319.80	40.2	11.17	4.00	6.16	26.2	16.2	3.4	13.5	100	295	65.00	18.06	3.69	5.68	21.7	13.7	3.0	11.1
131	806519	9/14/2019	A	28	M	1	75	63.83	167.6	26.70	450.0	255.3	419.3	30.7	6.82	5.59	6.57	31.4	19.6	3.5	15.2	100	405.10	44.90	9.98	5.40	6.35	29.8	17.3	4.1	13.1
132	741312	9/17/2019	B	45	F	2	61	49.55	157.4	24.62	350.0	198.2	357.90	-7.9	-2.26	5.87	7.22	25.6	15.1	3.2	12.5	100	322.4	27.60	7.89	5.29	6.51	22.6	12.1	3.6	9.6
133	813836	9/19/2019	A	50	M	1	80	73.11	177.8	25.31	510.0	292.5	406.30	103.7	20.33	5.08	5.56	34.6	15.9	4.1	14	100	328.5	181.50	35.59	4.11	4.49	24.1	14.6	3.1	12
134	811690	9/20/2019	A	59	M	1	60	68.47	172.7	22.96	480.0	273.9	439.70	40.3	8.40	7.33	6.42	16.5	14.5	4.4	13.5	100	371.6	108.40	22.58	6.19	5.43	13.3	19.3	3.7	18.3
135	817136	9/28/2019	A	83	M	1	66	63.83	167.6	23.50	450.0	255.3	413.80	36.2	8.04	6.27	6.48	29.3	17.2	4.1	13.9	100	356	94.00	20.89	5.39	5.58	26.3	16.7	3.6	14.7
136	819547	9/28/2019	B	57	M	1	66	63.83	167.6	22.72	450.0	255.3	426.50	23.5	5.22	6.46	6.68	22.6	13.6	4.1	12.6	100	325	125.00	27.78	4.92	5.09	17.8	19.8	3.2	18.8
137	775796	9/30/2019	A	40	M	1	84	68.47	172.7	22.96	480.0	273.9	437.20	42.8	8.92	5.20	6.38	20.9	22.9	4.4	21.9	100	369.4	110.60	23.04	4.40	5.39	17.6	27.6	3.7	26.6
138	43724	9/30/2019	A	48	F	2	90	56.47	165	20.74	400.0	225.9	368.50	31.5	7.88	4.09	6.53	23	15.0	3.7	14	100	302.4	97.60	24.40	3.36	5.36	23.4	21.4	3.0	20.4
139	820812	9/30/2019	A	37	F	1	78	54.19	162.5	20.52	380.0	216.8	344.00	36.0	9.47	4.41	6.35	23.5	26.5	3.4	25.5	100	285.4	94.60	24.89	3.66	5.27	17.6	19.6	2.9	18.6
140	79427	9/30/2019	A	73	M	1	80	70.80	175.26	23.05	500.0	283.2	458.40	41.6	8.32	5.73	6.47	24.4	14.4	4.6	13.4	100%	166.6	333.40	66.68	2.08	2.35	15.6	19.6	2.6	18.6
141	582500	10/1/2019	A	52	M	1	88	73.11	177.8	23.13	510.0	292.5	503.40	6.6	1.29	5.72	6.89	14.7	16.7	4.7	15.7	100	395.8	114.20	22.39	4.50	5.41	16.7	10.7	4.0	9.7
142	817763	10/1/2019	B	75	M	2	72	63.83	167.6	22.72	450.0	255.3	408.20	41.8	9.29	5.67	6.39	20.1	14.1	4.1	13.1	100	262.2	187.80	41.73	3.64	4.11	14.7	17.7	2.6	16.7
143	749016	10/7/2019	B	60	F	1	82	54.19	162.5	20.52	380.0	216.8	347.30	32.7	8.61	4.24	6.41	15.9	19.9	3.5	18.9	100	290.2	89.80	23.63	3.54	5.36	18.6	14.6	2.9	13.6
144	825530	10/8/2019	A	62	M	3	60	68.47	172.7	22.96	480.0	273.9	437.50	42.5	8.85	7.29	6.39	14.2	19.1	4.4	18.1	100	379.1	100.90	21.02	6.32	5.54	16	20.2	3.8	19.2
145	251132	10/9/2019	B	60	F	1	64	51.92	160	20.28	360.0	207.7	331.20	28.8	8.00	5.18	6.38	14.7	16.7	3.3	15.5	100	291.8	68.20	18.94	4.56	5.62	18.7	22.7	2.9	21.7
146	814566	10/9/2019	B	31	M	2	80	75.43	180.34	23.19	530.0	301.7	479.90	50.1	9.45	6.00	6.36	18.8	16.8	4.8	15.8	100	408.2	121.80	22.98	5.10	5.41	22.8	24.8	4.1	23.8
147	689076	10/9/2019	B	59	M	2	85	73.11	177.8	23.13	510.0	292.5	474.40	35.6	6.98	5.58	6.49	13.1	23.1	4.7	22.1	100	383.6	126.40	24.78	4.51	5.25	15.5	18.5	3.8	17.5
148	792708	10/10/2019	A	40	M	1	86	70.80	175.26	23.05	500.0	283.2	454.90	45.1	9.02	5.29	6.42	22.1	27.1	4.5	26.1	100	383.3	116.70	23.34	4.46	5.41	27.6	20.6	3.8	19.6
149	736117	10/11/2019	B	50	F	1	52	54.19	162.5	20.52	380.0	216.8	344.90	35.1	9.24	6.63	6.36	17.4	21.4	3.4	20.4	100	299	81.00	21.32	5.75	5.52	18.5	15.5	3.0	14.5
150	798483	10/11/2019	A	21	M	2	92	73.11	177.8	23.13	510.0	292.5	463.70	46.3	9.08	5.04	6.34	25.6	14.6	4.6	13.6	100	387.4	122.60	24.04	4.21	5.30	25.7	12.7	3.9	11.7
151	823005	10/14/2019	B	47	F	1	85	42.69	149.86	19.01	300.0	170.8	277.50	22.5	7.50	3.26	6.50	26.3	23.3	2.8	22.3	100	241	59.00	19.67	2.84	5.65	22	26	2.4	25
152	829146	10/14/2019	B	65	M	2	80	70.80	175.26	23.05	500.0	283.2	456.20	43.8	8.76	5.70	6.44	17.6	11.6	4.6	10.6	100	323.4	176.60	35.32	4.04	4.57	16.1	25.1	3.2	24.1
153	612708	10/15/2019	A	35	F	1	88	49.55	157.4	20.00	350.0	198.2	318.50	31.5	9.00	3.62	6.43	21.3	25.3	3.2	24.3	100	270.7	79.30	22.66	3.08	5.46	25.6	21.6	2.7	20.6
154	745428	10/15/2019	B	40	M	3	48	56.92	160	22.23	400.0	227.7	363.70	36.3	9.08	7.58	6.39	24.9	14.9	3.6	13.9	100	320.3	79.70	19.93	6.67	5.63	24.8	27.8	3.2	26.8
155	826098	10/16/2019	B	73	F	2	45	45.00	152.4	19.38	320.0	180.0	287.20	32.8	10.25	6.38	6.38	19.8	15.9	2.9	14.9	100	242.2	77.80	24.31	5.38	5.38	16.1	14.1	2.4	13.1
156	829146	10/16/2019	B	65	M	1	82	73.11	177.8	23.13	510.0	292.5	469.20	40.8	8.00	5.72	6.42	18	14.0	4.7	13	100	400	110.00	21.57	4.88	5.47	13.9	17.9	4.0	16.9
157	830422	10/17/2019	A	65	M	2	53	59.19	162.5	22.42	410.0	236.8	384.20	25.8	6.29	7.25	6.49	20.4	14.4	3.8	13.4	100	321.9	88.10	21.49	6.07	5.44	25.8	23.8	3.2	22.8
158	660192	10/17/2019	B	52	M	2	80	73.11	177.8	23.13	510.0	292.5	471.20	38.8	7.61	5.89	6.44	19.1	16.1	4.7	15.1	100	408.8	101.20	19.84	5.11	5.59	22.9	12.9	4.1	11.9
159	774360	10/18/2019	A	53	M	1	76	70.80	175.26	23.05	500.0	283.2	445.80	54.2	10.84	5.87	6.30	16.6	17.6	4.5	16.6	100	395	105.00	21.00	5.20	5.58	16.6	17.6	4.0	16.6
160	832238	10/19/2019	A	40	M	1	61	75.39	180.3	23.19	530.0	301.6	480.20	49.8	9.40	7.87	6.37	12.5	17.5	4.8	16.5	100	410	120.00	22.64	6.72	5.44	17.7	20.7	4.1	20.7
161	828831	10/19/2019	B	64	M	2	64	66.18	170.18	22.85	460.0	264.7	414.60	45.4	9.87	6.48	6.26	15.6	17.6	4.1	16.6	100	361.8	98.20	21.35	5.65	5.47	26.9	13.5	3.6	12.5
162	834021	10/22/2019	A	50	M	1	88	73.11	177.8	23.13	510.0	292.5	469.30	40.7	7.98	5.33	6.42	27.3	16.3	4.7	15.3	100	398	112.00	21.96	4.52	5.44	19.7	17.7	4.0	16.7
163	830443	10/24/2019	B	60	M	2	70	63.83	167.6	22.72	450.0	255.3	410.90	39.1	8.69	5.87	6.44	20.3	24.3	4.1	23.3	100	349.6	100.40	22.31	4.99	5.48	21.4	20.4	3.5	19.4
164	838448	10/24/2019	A	68	M	1	76	73.11	177.8	23.13	510.0	292.5	465.80	44.2	8.67	6.13	6.37	24.5	15.5	4.7	14.5	100	224	286.00	56.08	2.95	3.06	12.6	22.6	2.2	21.6
165	123067	10/30/2019	B	68	M	2	61	59.19	162.5	22.42	410.0	236.8	377.70	32.3	7.88	6.19	6.38	17	21.0	3.8	20	100	314.3	95.70	23.34	5.15	5.31	14	17	3.1	16
166	838627	10/30/2019	A	61	M	2	80	66.18	170.18	22.85	460.0	264.7	421.20	38.8	8.43	5.27	6.36	24.1	13.2	4.2	12.2	100	285.6	174.40	37.91	3.57	4.32	17.1	28.1	2.8	27.1
167	693170	10/30/2019	B	50	M	2	70	68.47	172.7	22.96	480.0	273.9	432.10	47.9	9.98	6.17	6.31	17.7	15.7	4.3	14.7	100	379.8	100.20	20.88	5.43	5.55	13.3	18.3	3.8	17.3
168	786971	10/31/2019	B	67	M	1	88	70.75	175.2	23.05	500.0	283.0	451.70	48.3	9.66	5.13	6.38	14.2	12.2	4.5	11.2	100	388.7	111.30	22.26	4.42	5.49	17.2	16.2	3.9	15.2
169	841926	11/4/2019	A	62	M	2	55	56.92	160	21.48	400.0	227.7	362.50	37.5	9.38	6.59	6.37	28.4	16.2	3.6	12.6	100	309.2	90.80	22.70	5.62	5.43	22.7	12.6	3.1	10.4
170	841965	11/4/2019	B	50	M	1	72	63.83	167.6	25.63	450.0	255.3	412.80	37.2	8.27	5.73	6.47	27.5	16.1	4.1	13.1	100	358.9	91.10	20.24	4.98	5.62	24	13.3	3.6	11.2
171	843076	11/5/2019	B	56	F	3	110	49.55	157.4	44.40	350.0	198.2	275.1	74.9	21.40	2.50	5.55	23.2	13.1	2.8	10.8	100	113.00	237.00	67.71	1.03	2.28	11.4	7	1.1	6.6
172	833306	11/5/2019	A	67	M	2	67	66.18	170.18	23.13	460.0	264.7	312.00	148.0	32.17	4.66	4.71	22.1	21.6	3.1	9.9	100	0	460.00	100.00	0.00	0.00	0	0	0.0	0
173	842821	11/5/2019	B	60	M	1	55	73.11	177.8	17.40	510.0	292.5	468.20	41.8	8.20	8.51	6.40	30.8	16.7	4.7	13.8	100	444.4	65.60	12.86	8.08	6.08	30.1	14.4	4.4	11.6
174	841644	11/5/2019	A	45	M	1	78	63.83	167.6	27.77	450.0	255.3	408.60	41.4	9.20	5.24	6.40	28.6	16.8	4.1	14	100	357.3	92.70	20.60	4.58	5.60	25.8	14.5	3.6	11.7
175	818553	11/6/2019	B	67	F	2	70	49.55	157.4	28.25	350.0	198.2	318.90	31.1	8.89	4.56	6.44	23.9	12.9	3.2	11.1	100	330	20.00	5.71	4.71	6.66	25	14	3.3	11.8
176	843474	11/6/2019	A	45	F	2	95	49.55	157.4	**38.35**	350.0	198.2	313.90	36.1	10.31	3.30	6.34	24.4	14.7	3.1	12.8	100	184	166.00	47.43	1.94	3.71	17.4	10.4	1.9	9.4
177	834146	11/8/2019	B	39	M	2	68	70.80	175.26	22.14	500.0	283.2	458.60	41.4	8.28	6.74	6.48	31.4	14.9	4.6	12.2	100	449.1	50.90	10.18	6.60	6.34	32.3	14.7	4.5	12.5
178	759825	11/9/2019	A	32	F	2	106	58.83	167.6	37.74	410.0	235.3	354.30	55.7	13.59	3.34	6.02	25	13.3	3.5	11.7	100	128.20	281.80	68.73	1.21	2.18	12.8	8.6	1.3	7.6
179	845886	11/10/2019	B	53	M	2	84	66.11	170.1	29.03	460.0	264.4	421.10	38.9	8.46	5.01	6.37	31.2	16.8	4.2	14.9	100	367.9	92.10	20.02	4.38	5.57	28	14.5	3.7	12.4
180	846389	11/10/2019	B	40	M	1	74	65.11	169	25.91	460.0	260.4	411.00	49.0	10.65	5.55	6.31	31	16.1	4.1	13.4	100	362.4	97.60	21.22	4.90	5.57	28	14.2	3.6	12.2
181	821298	11/11/2019	B	48	F	2	108	54.19	162.5	40.90	380.0	216.8	345.90	34.1	8.97	3.20	6.38	25.4	14.3	3.5	12.7	100	190.4	189.60	49.89	1.76	3.51	18.2	8.6	1.8	8
182	845294	11/11/2019	A	49	M	2	87	66.18	170.18	30.04	460.0	264.7	422.20	37.8	8.22	4.85	6.38	30.8	15.3	4.2	12.5	100	363.8	96.20	20.91	4.18	5.50	26.5	14.1	3.6	12.3
183	847863	11/13/2019	B	78	M	2	96	59.19	162.5	36.36	410.0	236.8	323.8	86.2	21.02	3.37	5.47	23.9	13.8	3.2	11.9	100	0.00	410.00	100.00	0.00	0.00	0	2.4	0.0	2
184	561033	11/17/2019	B	80	M	2	88	68.47	172.7	29.51	480.0	273.9	267.4	212.6	44.29	3.04	3.91	20.7	13.6	2.7	11.7	100	0.00	480.00	100.00	0.00	0.00	0	2.25	0.0	2
185	850976	11/18/2019	B	22	M	1	85	73.11	177.8	26.89	510.0	292.5	418.80	91.2	17.88	4.93	5.73	30.4	16.8	4.2	13.6	100	400.3	109.70	21.51	4.71	5.48	29.7	16.3	4.0	13.2
186	849681	11/18/2019	A	58	M	2	62	70.80	175.26	20.18	500.0	283.2	383.10	116.9	23.38	6.18	5.41	28	14.2	3.8	12.1	100	384.4	115.60	23.12	6.20	5.43	29	14.1	3.8	11.7
187	850905	11/18/2019	B	34	F	1	75	56.56	165.1	27.51	400.0	226.2	366.50	33.5	8.38	4.89	6.48	27.8	14.4	3.7	12	100	351.8	48.20	12.05	4.69	6.22	25.9	14	3.5	11.7
188	651734	11/18/2019	A	30	F	2	85	54.19	162.5	32.19	460.0	216.8	425.40	34.6	7.52	5.00	7.85	29.5	15.7	4.3	11.5	100	302.1	157.90	34.33	3.55	5.57	26.9	13.2	3.0	9.5
189	851189	11/19/2019	A	64	M	1	85	59.19	162.5	32.20	450.0	236.8	333.56	116.4	25.88	3.92	5.64	26.9	13.8	3.3	11.4	100%	0	450.00	100.00	0.00	0.00	0	2.4	0.0	2
190	823165	11/19/2019	A	52	M	2	65	66.18	170.18	22.44	460.0	264.7	395.70	64.3	13.98	6.09	5.98	29.9	16.8	4.0	12.8	100	421.2	38.80	8.43	6.48	6.36	32.2	18.4	4.2	14.2
191	830326	11/19/2019	B	90	M	1	80	73.11	177.8	25.31	510.0	292.5	375.4	134.6	26.39	4.69	5.13	28	14.3	3.8	12.5	100	110.80	399.20	78.27	1.39	1.52	11.4	11	1.1	10.4
192	847789	11/19/2019	B	31	M	2	90	73.11	177.8	28.47	510.0	292.5	462.00	48.0	9.41	5.13	6.32	34.2	20.9	4.6	18.8	100	411.7	98.30	19.27	4.57	5.63	31.7	16.9	4.1	14.8

Sr. No	Admission No		Failed E-C and rescue with V-E										Predictors of DMV										Operator Characteristics				
		SpO2	Vte	Airleak	Airleak	Vte/AW	Vte/PW	EtCO2	PIP	MV	Plateau	SpO2	Age >51yr	BM1>31	Snoring	OSA	Beard	Edentulous	TM Distance <6cm	MPS 3	MPS4	OTHERS	5-10 Yr	10-15yr	>15Yr	AGE	SEX
129	794273	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	N	Y	N	-	Y	-	44	M
130	793540	100	-	-	-	-	-	-	-	-	-	-	N	Y	N	N	N	N	N	Y	N	N	-	Y	-	44	M
131	806519	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	Y	N	N	Y	N	N	-	Y	-	43	M
132	741312	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	N	Y	N	-	Y	-	44	F
133	813836	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	N	Y	N	-	Y	-	44	M
134	811690	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	Y	N	N	N	N	N	-	Y	-	43	M
135	817136	100	-	-	-	-	-	-	-	-	-	-	Y	N	Y	N	N	Y	N	N	N	N	-	Y	-	42	M
136	819547	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	N	Y	N	-	Y	-	43	M
137	775796	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	Y	N	N	Y	N	N	-	Y	-	43	F
138	43724	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	-	Y	-	42	F
139	820812	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	-	Y	-	43	F
140	79427	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	Y	Y	N	N	Y	N	-	Y	-	43	F
141	582500	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	Y	N	N	N	N	N	-	Y	-	42	F
142	817763	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	Y	N	N	Y	N	-	Y	-	42	F
143	749016	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	N	-	Y	-	42	F
144	825530	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	N	-	Y	-	43	F
145	251132	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	N	-	Y	-	44	F
146	814566	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	Y	N	N	N	N	N	-	Y	-	43	F
147	689076	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	N	-	Y	-	44	F
148	792708	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	-	Y	-	43	F
149	736117	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	Y	Y	N	N	-	Y	-	42	F
150	798483	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	Y	-	-	38	F
151	823005	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	-	Y	-	43	F
152	829146	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	N	Y	N	-	Y	-	44	F
153	612708	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	-	Y	-	43	F
154	745428	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	-	Y	-	42	F
155	826098	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	Y	N	N	N	N	-	Y	-	44	F
156	829146	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	Y	N	N	N	N	N	-	Y	-	42	F
157	830422	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	N	-	Y	-	43	F
158	660192	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	Y	N	N	Y	N	N	-	Y	-	44	F
159	774360	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	Y	N	N	N	-	Y	-	42	F
160	832238	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	-	Y	-	44	F
161	828831	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	N	-	Y	-	44	F
162	834021	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	Y	N	N	N	N	N	-	Y	-	43	F
163	830443	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	N	-	Y	-	43	F
164	838448	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	Y	Y	N	N	N	N	-	Y	-	44	F
165	123067	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	Y	N	N	N	N	N	-	Y	-	44	F
166	838627	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	Y	N	N	N	N	N	-	Y	-	42	M
167	693170	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	Y	N	N	N	N	N	-	Y	-	42	F
168	786971	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	N	-	Y	-	44	F
169	841926	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	Y	N	N	N	N	N	-	Y	-	42	F
170	841965	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	Y	N	N	N	N	N	Y	-	-	34	F
171	843076	100	310.75	39.3	11.21	2.83	6.27	26	14.6	3.1	11	100	Y	Y	N	N	N	N	Y	N	N	N	Y	-	-	34	F
172	833306	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	Y	N	N	N	Y	RE	-	Y	-	42	M
173	842821	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	Y	N	N	Y	N	N	-	Y	-	42	F
174	841644	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	Y	N	N	N	N	N	Y	-	-	34	F
175	818553	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	N	-	Y	-	44	F
176	843474	100	-	-	-	-	-	-	-	-	-	-	N	Y	Y	N	N	N	N	N	N	N	Y	-	-	34	F
177	834146	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	-	Y	-	43	F
178	759825	100	-	-	-	-	-	-	-	-	-	-	N	Y	N	N	N	N	N	Y	N	NC	Y	-	-	38	M
179	845886	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	N	Y	N	-	Y	-	44	F
180	846389	100	-	-	-	-	-	-	-	-	-	-	N	N	Y	N	Y	N	N	N	N	N	-	-	Y	52	M
181	821298	100	307.75	72.3	19.01	2.85	5.68	23.8	13	3.1	11.4	100	N	Y	N	N	N	N	Y	N	N	NC	-	Y	-	38	F
182	845294	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	N	Y	N	-	Y	-	42	F
183	847863	100	332.00	78.0	19.02	3.46	5.61	26.2	13.8	3.3	11.8	100	Y	Y	N	N	N	N	Y	N	N	N	-	Y	-	38	M
184	561033	100	238.20	241.8	50.38	2.71	3.48	19.4	13	2.4	11	100	Y	N	N	N	N	Y	N	Y	N	N	-	Y	-	42	M
185	850976	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	Y	N	N	N	N	N	-	Y	-	42	M
186	849681	100	-	-	-	-	-	-	-	-	-	-	Y	N	Y	N	N	N	Y	N	N	N	-	Y	-	52	M
187	850905	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	N	Y	N	-	Y	-	38	M
188	651734	100	-	-	-	-	-	-	-	-	-	-	N	Y	N	N	N	N	N	Y	N	N	-	Y	-	44	F
189	851189	100	-	-	-	-	-	-	-	-	-	-	Y	Y	N	N	N	Y	N	N	N	N	Y	-	-	34	F
190	823165	100	-	-	-	-	-	-	-	-	-	-	Y	N	Y	N	N	N	N	N	N	N	-	Y	-	44	F
191	830326	100	351.25	158.8	31.13	4.39	4.80	27.8	13.8	3.6	12.2	100	Y	N	N	N	Y	N	Y	Y	N	N	-	Y	-	42	M
192	847789	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	-	Y	-	44	F

Sr. No	Admission No	Date	Treatment Group	Patient's Demographics							Set Tidal Volume (7ml/kg of PBW)	Failure cut-off (4ml/kg of PBW)	V-E										E-C									
				Age	Gender	ASA	Weight	Predicted Body Weight	Height	BMI			Vte	Airleak	Airleak (%)	Vte/AW	Vte/PW	EtCO2	PIP	MV	Plateau	SpO2 (%)	Vte	Airleak	Airleak (%)	Vte/AW	Vte/PW	EtCO2	PIP	MV	Plateau
193	769377	11/19/2019	B	19	M	2	124	82.36	187.96	35.10	580.0	329.4	525.90	54.1	9.33	4.24	6.39	35.1	17.1	5.3	14.9	100	422.6	157.40	27.14	3.41	5.13	32	20.1	4.2	17.5
194	851443	11/19/2019	B	40	F	2	113	56.56	165.1	41.46	400.0	226.2	367.6	32.4	8.10	3.25	6.50	28.3	15.8	3.7	13.7	100	254.00	146.00	36.50	2.25	4.49	21.9	15.3	2.5	13.3
195	811936	11/19/2019	A	67	F	1	70	54.19	162.5	26.51	380.0	216.8	340.80	39.2	10.32	4.87	6.29	27.6	12.8	3.4	11.2	100%	109.4	270.60	71.21	1.56	2.02	10.4	13.4	0.2	12
196	851389	11/19/2019	B	50	F	2	60	54.19	162.5	22.72	380.0	216.8	349.60	30.4	8.00	5.83	6.45	25.9	15.6	3.5	13.4	100	335.7	44.30	11.66	5.60	6.19	24.1	15.9	3.0	14.5
197	851336	11/19/2019	B	74	M	2	80	70.57	175	26.12	490.0	282.3	336.30	153.7	31.37	4.20	4.77	22.8	14.8	3.4	13.3	100	295	195.00	39.80	3.69	4.18	20.9	15.4	3.0	13.6
198	852309	11/20/2019	A	59	M	2	93	61.56	165.1	34.12	430.0	246.2	336.5	93.5	21.74	3.62	5.47	23.3	12.1	3.4	10.8	100	187.20	242.80	56.47	2.01	3.04	12	14.6	1.9	12.4
199	851558	11/20/2019	A	80	F	3	76	54.19	162.5	28.78	380.0	216.8	336.30	43.7	11.50	4.43	6.21	23.6	16.2	3.4	14.4	100	295	85.00	22.37	3.88	5.44	22.7	11.4	3.0	10.5
200	640529	11/20/2019	A	72	F	2	60	45.00	152.4	25.83	320.0	180.0	335.40	-15.4	-4.81	5.59	7.45	27.4	12.9	3.4	11.4	100	201	119.00	37.19	3.35	4.47	18.3	14.3	2.0	12.5
201	852797	11/21/2019	B	37	M	1	61	59.19	162.5	23.10	410.0	236.8	378.30	31.7	7.73	6.20	6.39	26.6	31.4	3.8	14.1	100	379.8	30.20	7.37	6.23	6.42	26.6	13.5	3.2	12.1
202	828904	11/21/2019	A	23	M	2	120	75.12	180	37.04	530.0	300.5	472.40	57.6	10.87	3.94	6.29	34.1	12.5	4.7	10.6	100	333.3	196.70	37.11	2.78	4.44	23.5	14.4	3.3	12.7
203	447203	11/21/2019	A	53	M	1	72	70.80	175.26	23.44	500.0	283.2	418.80	81.2	16.24	5.82	5.92	31.2	14.4	4.2	12.4	100%	17.7	482.30	96.46	0.25	0.25	3.8	15.5	3.1	16.6
204	794988	11/21/2019	B	46	M	2	90	61.18	170.18	31.08	460.0	244.7	430.98	29.0	6.31	4.79	7.04	19.9	18.38	4.1	17.3	100	342.5	117.50	25.54	3.81	5.60	17.7	20.1	3.4	19.1
205	853278	11/21/2019	A	45	M	2	136	63.83	167.6	48.42	450.0	255.3	326.70	123.3	27.40	2.40	5.12	26.1	14.7	3.3	12.4	100	0	450.00	100.00	0.00	0.00	0	0	0.0	0
206	793405	11/22/2019	B	80	F	1	62	54.19	162.5	23.48	500.0	216.8	354.10	145.9	29.18	5.71	6.53	25.9	15.6	3.5	13.4	100%	319.7	180.30	36.06	5.16	5.90	24.1	15.9	3.2	13.9
207	826865	11/23/2019	B	18	F	2	85	54.19	162.5	32.19	380.0	216.8	348.30	31.7	8.34	4.10	6.43	25.2	16.1	3.5	13.3	100	347.5	32.50	8.55	4.09	6.41	25.3	16	3.4	13.9
208	855176	11/24/2019	A	33	M	1	52	63.83	167.6	18.51	450.0	255.3	409.30	40.7	9.04	7.87	6.41	31	15.4	4.1	12.9	100	402.8	47.20	10.49	7.75	6.31	30	18	4.0	15.7
209	665132	11/25/2019	A	52	M	2	55	63.83	167.6	20.2	450.0	255.3	354.60	95.4	21.20	6.45	5.56	26	13.4	3.5	11.7	100	307	143.00	31.78	5.58	4.81	25.1	18	3.1	15.4
210	855256	11/25/2019	B	67	M	2	90	61.56	165.1	33.02	430.0	246.2	342.4	87.6	20.37	3.80	5.56	26	14.6	3.4	12.8	100	111.60	318.40	74.05	1.24	1.81	12.8	13.6	1.1	11.8
211	853841	11/25/2019	A	35	M	2	90	71.48	176	29.05	500.0	285.9	405.90	94.1	18.82	4.51	5.68	29.9	16.9	4.6	14.7	100	397.6	102.40	20.48	4.42	5.56	29.1	19.9	4.0	16.8
212	345220	11/25/2019	A	50	M	2	89	68.47	172.7	29.84	480.0	273.9	439.70	40.3	8.40	4.94	6.42	32.9	16.6	4.4	14.2	100	377.5	102.50	21.35	4.24	5.51	27.1	17.7	3.8	14.9
213	855270	11/25/2019	A	64	F	1	68	56.56	165.1	24.95	400.0	226.2	363.90	36.1	9.03	5.35	6.43	27	15.2	3.6	13.3	100	358.9	41.10	10.28	5.28	6.35	26.8	17.6	3.6	15
214	705179	11/25/2019	**A**	57	M	3	82	73.11	177.8	25.94	510.0	292.5	432.61	77.4	15.17	5.28	5.92	20.3	18.458	4.1	17.4	100	340.5	169.50	33.24	4.15	4.66	16.8	20.8	3.4	19.8
215	848728	11/25/2019	A	62	M	1	88	68.47	172.7	29.51	480.0	273.9	433.80	46.2	9.63	4.93	6.34	32	15.3	4.3	13.5	100	370.3	109.70	22.85	4.21	5.41	29.3	18.3	3.7	14.9
216	855395	11/26/2019	B	44	M	2	68	68.47	172.7	22.80	480.0	273.9	363.2	116.8	24.33	5.34	5.30	26	13.1	3.6	11.7	100	347.10	132.90	27.69	5.10	5.07	25.6	16.5	3.5	14
217	810393	11/26/2019	A	41	F	2	81	49.55	157.4	32.69	350.0	198.2	312.00	38.0	10.86	3.85	6.30	26.1	11.5	3.1	10	100	272.3	77.70	22.20	3.36	5.50	24.8	16.5	2.7	14.2
218	695621	11/26/2019	A	54	M	1	92	70.75	175.2	23.05	500.0	283.0	453.00	47.0	9.40	4.92	6.40	20.4	23.4	4.5	22.4	100	377.4	122.60	24.52	4.10	5.33	17.8	27.8	3.8	26.8
219	857503	11/27/2019	A	37	F	2	76	54.19	162.5	28.78	380.0	216.8	343.40	36.6	9.63	4.52	6.34	27.9	13.4	3.4	11.7	100	338.7	41.30	10.87	4.46	6.25	26.2	17	3.3	15
220	851384	11/27/2019	B	70	M	1	78	59.19	162.5	29.54	410.0	236.8	374.90	35.1	8.56	4.81	6.33	28.2	13.1	3.7	11.9	100	351.6	58.40	14.24	4.51	5.94	26.9	15.9	3.2	14.5
221	857366	11/28/2019	A	63	F	2	60	54.19	162.5	22.72	380.0	216.8	332.10	47.9	12.61	5.54	6.13	27.1	14.6	3.4	12.6	100	329.2	50.80	13.37	5.49	6.07	27.5	18.3	3.2	15.6
222	855489	11/28/2019	A	52	F	2	69	45.00	152.4	29.71	320.0	180.0	289.50	30.5	9.53	4.20	6.43	26.7	12.1	2.9	10.9	100	293.3	26.70	8.34	4.25	6.52	25.1	15.1	2.9	13.5
223	793915	11/28/2019	B	56	M	2	77	70.75	175.2	25.09	500.0	283.0	449.80	50.2	10.04	5.84	6.36	32.2	15.9	4.5	14.2	100	415	85.00	17.00	5.39	5.87	31.1	18.6	4.1	16.9
224	857453	11/28/2019	A	60	M	2	68	70.75	175.2	22.15	500.0	283.0	373.67	126.3	25.27	5.50	5.28	27.4	12.7	3.7	11.4	100%	168.4	331.60	66.32	2.48	2.38	13.2	13.4	1.7	12
225	816872	11/28/2019	B	37	M	2	86	59.19	162.5	32.57	410.0	236.8	321	89.0	21.71	3.73	5.42	25.2	12.7	3.2	11.6	100	166.80	243.20	59.32	1.94	2.82	16.6	12.6	1.7	11.2
226	785278	11/28/2019	A	60	F	1	68	54.19	162.5	25.75	380.0	216.8	345.60	34.4	9.05	5.08	6.38	24.8	12.4	3.5	11.3	100	356.3	23.70	6.24	5.24	6.57	25	16.1	3.5	14.8
227	855725	11/28/2019	A	65	F	3	47	51.92	160	18.36	360.0	207.7	334.00	26.0	7.22	7.11	6.43	24.8	12.6	3.3	11.6	100	218.6	141.40	39.28	4.65	4.21	20.6	14.1	3.2	12.6
228	855471	11/28/2019	B	65	M	3	65	73.11	177.8	20.56	510.0	292.5	471.10	38.9	7.63	7.25	6.44	31.7	16.1	4.7	14.3	100	402.1	107.90	21.16	6.19	5.50	29.4	17	4.0	15.9
229	857139	11/29/2019	A	77	F	2	38	45.00	152.4	16.36	320.0	180.0	273.6	46.4	14.50	7.20	6.08	21.4	11.6	2.7	10.1	100	108.40	211.60	66.13	2.85	2.41	12.6	13.8	1.1	12
230	857370	11/29/2019	A	51	F	3	77	56.56	165.1	28.25	400.0	226.2	366.70	33.3	8.33	4.76	6.48	26.2	12.3	3.7	11.4	100	365.9	34.10	8.53	4.75	6.47	26.4	14.6	3.6	12.2
231	315185	11/30/2019	A	50	F	2	70	56.56	165.1	25.68	400.0	226.2	291.40	108.6	27.15	4.16	5.15	22.5	12.9	2.5	11.5	100	295.7	104.30	26.08	4.22	5.23	22.8	15.3	3.0	12.8
232	537386	11/30/2019	B	34	F	1	60	51.92	160	23.44	360.0	207.7	333.70	26.3	7.31	5.56	6.43	25.2	12.9	3.3	10.9	100	325.5	34.50	9.58	5.43	6.27	24.3	15.4	3.2	13.2
233	546958	11/30/2019	A	55	F	1	76	46.46	154	32.05	330.0	185.8	312.3	17.7	5.36	4.11	6.72	24.9	12.8	3.1	11.4	100	300.30	29.70	9.00	3.95	6.46	23.9	15.0	3.0	13
234	789549	12/2/2019	A	29	M	2	90	66.18	170.18	31.10	460.0	264.7	412.10	47.9	10.41	4.58	6.23	30.5	14.7	4.1	13.1	100	411.4	48.60	10.57	4.57	6.22	30.8	18.4	4.1	16.5
235	862345	12/7/2019	A	22	M	1	66	68.47	172.7	22.13	480.0	273.9	443.3	36.7	7.65	6.72	6.47	32	15.9	4.4	13.1	100	441.30	38.70	8.06	6.69	6.44	32.2	19.8	4.4	17.7
236	720743	12/11/2019	B	58	M	1	80	68.47	172.7	26.82	480.0	273.9	428.94	51.1	10.64	5.36	6.26	19.6	18.6738	4.0	17.6	100	334.8	145.20	30.25	4.19	4.89	16.5	21.1	3.3	20.1
237	864938	12/11/2019	B	50	M	1	65	66.18	170.18	22.44	460.0	264.7	347.6	112.4	24.43	5.35	5.25	24.9	12.3	3.6	10.5	100	352.00	108.00	23.48	5.42	5.32	25.7	15.3	3.2	13.6
238	864852	12/12/2019	B	60	M	2	76	74.21	179	23.72	520.0	296.8	407	113.0	21.73	5.36	5.48	30.9	13	4.1	11.6	100	276.80	243.20	46.77	3.64	3.73	24	16	2.9	14.2
239	865007	12/13/2019	A	75	M	2	80	63.83	167.6	28.48	450.0	255.3	359.56	90.4	20.10	4.49	5.63	25.8	13	3.6	11.4	100	104.00	346.00	76.89	1.30	1.63	11.6	11.4	1.0	10
240	863838	12/13/2019	B	58	F	2	104	51.92	160	40.63	360.0	207.7	335.10	24.9	6.92	3.22	6.45	24.4	14.2	3.3	12.2	100	285.1	74.90	20.81	2.74	5.49	22.2	13.7	2.9	12.3
241	867100	12/15/2019	A	42	M	2	65	70.80	175.26	21.16	500.0	283.2	392.10	107.9	21.58	6.03	5.54	28.2	15.2	4.6	13.6	100	391.1	108.90	21.78	6.02	5.52	27.3	18.3	3.9	16
242	600743	12/17/2019	B	42	M	2	55	68.47	172.7	18.44	480.0	273.9	365.3	114.7	23.90	6.64	5.33	25	14.9	3.7	12.9	100	369.80	110.20	22.96	6.72	5.40	25.4	17.5	4.4	15
243	868632	12/18/2019	A	57	M	2	74	66.18	170.18	25.55	460.0	264.7	424.80	35.2	7.65	5.74	6.42	31.8	15.6	4.2	13.5	100	368.3	91.70	19.93	4.98	5.57	27	18	3.7	15.7
244	860441	12/20/2019	B	50	M	2	100	63.83	167.6	35.60	450.0	255.3	366	84.0	18.67	3.66	5.73	27.9	15	3.7	12.8	100	119.00	331.00	73.56	1.19	1.86	12.4	16.8	1.2	14.2
245	383174	12/20/2019	A	57	M	2	72	68.47	172.7	24.14	480.0	273.9	440.50	39.5	8.23	6.12	6.43	26.8	14.8	4.4	12.8	100	374.9	105.10	21.90	5.21	5.48	23.7	18	3.7	15.7
246	861120	12/20/2019	B	40	F	1	71	56.56	165.1	26.05	400.0	226.2	358.10	41.9	10.48	5.04	6.33	24	13.1	3.6	11	100	383.4	16.60	4.15	5.40	6.78	23.9	14.5	3.8	12.3
247	874293	1/1/2020	A	80	F	2	45	45.00	152.4	19.38	320.0	180.0	282.50	37.5	11.72	6.28	6.28	24.8	12.2	2.8	10.8	100	135.25	184.75	57.73	3.01	3.01	12.5	13.25	1.3	11
248	874587	1/1/2020	B	58	F	3	96	51.92	160	37.50	360.0	207.7	335.20	24.8	6.89	3.49	6.46	23.9	12.6	3.4	11.2	100	149	211.00	58.61	1.55	2.87	12.4	12.4	1.4	10.8
249	874420	1/1/2020	A	61	F	2	86	55.56	164	31.98	390.0	222.2	348.00	42.0	10.77	4.05	6.26	22.1	12.9	3.5	11.5	100	299.4	90.60	23.23	3.48	5.39	23.7	14.4	3.0	12.6
250	595952	1/1/2020	A	45	M	3	62	66.11	170.1	21.43	460.0	264.4	249.20	210.8	45.83	4.02	3.77	19.8	9.5	2.5	6.7	100	231.6	228.40	49.65	3.74	3.50	17.6	9.7	2.3	6.3
251	874644	1/1/2020	B	54	F	1	78	51.92	160	30.47	360.0	207.7	323.2	36.8	10.22	4.14	6.23	25.8	13.9	3.2	22.1	100	280.10	79.90	22.19	3.59	5.40	22	16.5	2.8	14.8
252	610858	1/2/2020	A	53	M	2	55	61.56	165.1	20.18	430.0	246.2	381	49.0	11.40	6.93	6.19	29.1	11.9	3.8	10.5	100	382.60	47.40	11.02	6.96	6.22	26.8	8.8	3.8	8
253	755991	1/2/2020	B	54	M	2	84	75.43	180.34	25.83	530.0	301.7	469.70	60.3	11.38	5.59	6.23	31	13.1	4.7	11.5	100	323.8	206.20	38.91	3.85	4.29	26.8	15	3.2	13.2
254	874860	1/2/2020	A	28	M	2	87	68.47	172.7	29.17	480.0	273.9	443.00	37.0	7.71	5.09	6.47	29.1	11.9	4.4	10.5	100	430.9	49.10	10.23	4.95	6.29	26.4	14.8	4.3	13.1
255	870938	1/2/2020	A	54	M	2	91	68.47	172.7	31.50	480.0	273.9	372.9	107.1	22.31	4.10	5.45	27.3	12.4	3.7	11.5	100	230.20	249.80	52.04	2.53	3.36	23.6	15	2.3	12.8
256	874707	1/2/2020	A	57	F	2	78	63.47	172.7	26.15	440.0	253.9	378.60	61.4	13.95	4.85	5.96	24.8	10.1	3.8	8.5	100	365.5	74.50	16.93	4.69	5.76	19.1	12.8	3.7	11.2

Sr. No	Admission No		Failed E-C and rescue with V-E										Predictors of DMV										Operator Characteristics				
		SpO2	Vte	Airleak	Airleak	Vte/AW	Vte/PW	EtCO2	PIP	MV	Plateau	SpO2	Age >51yr	BM1>31	Snoring	OSA	Beard	Edentulous	TM Distance <6cm	MPS 3	MPS4	OTHERS	5-10 Yr	10-15yr	>15Yr	AGE	SEX
193	769377	100	-	-	-	-	-	-	-	-	-	-	N	Y	N	N	N	N	N	N	N	N	Y	-	-	34	F
194	851443	100	-	-	-	-	-	-	-	-	-	-	N	Y	Y	N	N	N	N	Y	N	N	-	-	Y	52	M
195	811936	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	Y	N	N	N	N	-	Y	-	44	F
196	851389	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	-	-	Y	52	M
197	851336	100	-	-	-	-	-	-	-	-	-	-	Y	N	Y	N	N	Y	N	N	N	N	Y	-	-	38	M
198	852309	100	-	-	-	-	-	-	-	-	-	-	Y	Y	N	N	N	N	N	Y	N	N	-	Y	-	44	F
199	851558	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	N	-	Y	-	44	F
200	640529	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	Y	N	Y	N	N	Y	-	-	34	F
201	852797	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	Y	-	-	38	M
202	828904	100	-	-	-	-	-	-	-	-	-	-	N	Y	N	N	N	N	N	Y	N	N	-	Y	-	42	F
203	447203	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	N	Y	N	-	Y	-	42	F
204	794988	100	-	-	-	-	-	-	-	-	-	-	N	Y	N	N	Y	N	N	N	Y	N	-	Y	-	43	F
205	853278	100	-	-	-	-	-	-	-	-	-	-	N	Y	N	N	N	N	N	N	N	N	-	Y	-	44	F
206	793405	100%	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	N	Y	N	-	Y	-	44	F
207	826865	100	-	-	-	-	-	-	-	-	-	-	N	Y	N	N	N	N	N	N	N	N	-	Y	-	43	F
208	855176	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	N	Y	N	Y	-	-	38	F
209	665132	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	Y	N	N	Y	N	N	Y	-	-	38	M
210	855256	100	348.00	82.0	19.07	3.87	5.65	26.4	14.4	3.5	12.6	100	Y	Y	N	N	Y	N	N	N	N	N	-	Y	-	44	F
211	853841	100	-	-	-	-	-	-	-	-	-	-	N	N	Y	N	N	N	N	Y	N	NC	Y	-	-	34	F
212	345220	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	Y	N	N	N	Y	N	-	Y	-	42	M
213	855270	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	N	-	-	Y	52	M
214	705179	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	N	Y	-	-	38	M
215	848728	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	N	Y	N	Y	-	-	38	M
216	855395	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	Y	-	-	34	F
217	810393	100	-	-	-	-	-	-	-	-	-	-	N	Y	N	N	N	N	N	N	N	N	-	Y	-	50	F
218	695621	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	Y	N	N	N	N	N	-	Y	-	44	F
219	857503	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	-	Y	-	43	F
220	851384	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	N	Y	N	-	Y	-	38	M
221	857366	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	N	-	Y	-	43	F
222	855489	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	N	-	Y	-	43	F
223	793915	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	N	Y	-	-	34	F
224	857453	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	Y	N	N	N	N	-	Y	-	42	F
225	816872	100	324.75	85.3	20.79	3.78	5.49	25	11.8	3.2	10.8	100	N	Y	N	N	N	N	N	N	N	N	-	Y	-	44	F
226	785278	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	N	-	Y	-	42	F
227	855725	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	Y	N	Y	N	N	-	Y	-	43	F
228	855471	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	Y	N	N	N	N	N	-	Y	-	42	F
229	857139	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	Y	N	N	N	N	-	Y	-	43	F
230	857370	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	Y	-	-	34	F
231	315185	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	-	Y	-	42	F
232	537386	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	RE	Y	-	-	38	F
233	546958	100	-	-	-	-	-	-	-	-	-	-	Y	Y	N	N	N	N	N	Y	N	N	-	Y	-	42	F
234	789549	100	-	-	-	-	-	-	-	-	-	-	N	Y	N	N	N	N	N	Y	N	N	-	Y	-	42	M
235	862345	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	N	Y	N	Y	-	-	38	M
236	720743	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	Y	N	N	Y	N	N	-	Y	-	44	F
237	864938	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	Y	N	N	Y	N	N	-	Y	-	43	F
238	864852	100	416.20	103.8	19.96	5.48	5.61	30.8	12.4	4.0	12.2	100	Y	N	N	N	Y	N	N	N	Y	N	-	Y	-	42	M
239	865007	100	-	-	-	-	-	-	-	-	-	-	Y	N	Y	N	Y	N	N	N	Y	CERVICAL COLLAR	Y	-	-	38	M
240	863838	100	-	-	-	-	-	-	-	-	-	-	Y	Y	N	N	N	N	N	N	N	N	-	Y	-	42	M
241	867100	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	Y	N	N	N	N	N	-	Y	-	44	F
242	600743	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	N	Y	N	-	Y	-	43	F
243	868632	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	Y	N	N	Y	N	N	-	-	Y	53	F
244	860441	100	334.00	116.0	25.78	3.34	5.23	25	14.6	3.3	12.4	100	N	Y	Y	N	Y	N	N	N	N	N	-	Y	-	43	F
245	383174	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	Y	N	N	N	N	N	-	Y	-	44	F
246	861120	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	-	-	Y	53	F
247	874293	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	Y	N	Y	N	N	Y	-	-	34	F
248	874587	100	304.75	55.3	15.35	3.17	5.87	23.2	12.4	2.8	10.6	100	Y	Y	N	N	N	N	N	Y	N	N	-	Y	-	44	F
249	874420	100	-	-	-	-	-	-	-	-	-	-	Y	Y	N	N	N	N	N	N	N	N	-	Y	-	43	F
250	595952	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	Y	N	N	N	N	N	Y	-	-	38	F
251	874644	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	N	Y	N	-	-	Y	52	M
252	610858	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	N	-	Y	-	44	F
253	755991	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	Y	N	Y	N	N	Y	-	-	34	F
254	874860	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	Y	N	N	N	N	-	Y	-	42	M
255	870938	100	-	-	-	-	-	-	-	-	-	-	Y	Y	Y	N	N	N	N	N	N	N	-	Y	-	44	F
256	874707	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	N	Y	-	-	38	F

Sr. No	Admission No	Date	Treatment Group	Patient's Demographics							Set Tidal Volume (7ml/kg of PBW)	Failure cut-off (4ml/kg of PBW)	V-E										E-C								
				Age	Gender	ASA	Weight	Predicted Body Weight	Height	BMI			Vte	Airleak	Airleak (%)	Vte/AW	Vte/PW	EtCO2	PIP	MV	Plateau	SpO2 (%)	Vte	Airleak	Airleak (%)	Vte/AW	Vte/PW	EtCO2	PIP	MV	Plateau
257	870178	1/2/2020	B	32	F	2	88	56.56	165.1	32.28	400.0	226.2	368.80	31.2	7.80	4.19	6.52	26.4	15.4	3.7	14	100	312.8	87.20	21.80	3.55	5.53	21.9	16.9	3.1	15.4
258	69025	1/3/2020	A	45	F	2	96	46.46	154	40.48	330.0	185.8	298.50	31.5	9.55	3.11	6.43	24.1	15.5	3.0	13.7	100	209	121.00	36.67	2.18	4.50	20.5	19.5	2.1	18.2
259	875232	1/3/2020	B	54	F	1	88	54.19	162.5	33.33	380.0	216.8	345.90	34.1	8.97	3.93	6.38	29.9	15.1	3.5	13.2	100	293.1	86.90	22.87	3.33	5.41	21.6	18.4	2.9	16.4
260	876657	1/6/2020	A	52	M	2	80	70.75	175.2	26.06	500.0	283.0	332.70	167.3	33.46	4.16	4.70	26.8	8.8	3.4	8	100	320.3	179.70	35.94	4.00	4.53	23.8	13.7	3.1	11.8
261	439771	1/7/2020	B	55	M	2	67	61.56	165.1	24.58	430.0	246.2	392.20	37.8	8.79	5.85	6.37	26.9	15.8	3.9	14.1	100	416.8	13.20	3.07	6.22	6.77	30.6	14.1	4.2	12.4
262	387765	1/7/2020	A	66	F	3	60	51.92	160	23.44	360.0	207.7	327.00	33.0	9.17	5.45	6.30	25.8	10.5	3.3	8.7	100	158.2	201.80	56.06	2.64	3.05	16.6	19.6	1.5	17.6
263	697989	1/7/2020	B	60	M	1	82	70.80	175.26	26.70	500.0	283.2	455.30	44.7	8.94	5.55	6.43	24.8	12.8	4.6	11.2	100	398.5	101.50	20.30	4.86	5.63	19.1	16.8	4.0	15.1
264	699254	1/7/2020	A	56	M	2	90	66.11	170.1	31.11	460.0	264.4	425.90	34.1	7.41	4.73	6.44	24.5	19.3	4.3	17.5	100	360.4	99.60	21.65	4.00	5.45	19.8	24.6	3.6	22.6
265	877323	1/7/2020	B	65	F	2	66	51.92	160	25.78	360.0	207.7	323.10	36.9	10.25	4.90	6.22	26.9	13.6	3.4	11.8	100	321.5	38.50	10.69	4.87	6.19	29.8	16.8	3.2	15.7
266	877260	1/7/2020	A	54	M	2	80	75.43	180.34	24.60	530.0	301.7	485.60	44.4	8.38	6.07	6.44	31.6	13.1	4.9	11.7	100	400.9	129.10	24.36	5.01	5.32	26.4	17	4.0	15.8
267	860863	1/7/2020	B	61	F	1	54	49.55	157.4	21.80	350.0	198.2	332.50	17.5	5.00	6.16	6.71	26.2	12.0	3.4	11.1	100	325.3	24.70	7.06	6.02	6.57	23	16	3.2	14.4
268	877442	1/8/2020	A	35	M	2	65	68.47	172.7	21.79	480.0	273.9	434.40	45.6	9.50	6.68	6.34	22.2	18.1	4.3	17.2	100	379.6	100.40	20.92	5.84	5.54	17.2	25.8	3.8	24.5
269	877781	1/8/2020	A	71	M	2	66	63.83	167.6	23.50	450.0	255.3	400.30	49.7	11.04	6.07	6.27	17.9	14.8	4.0	13	100	368.8	81.20	18.04	5.59	5.78	12.5	17.1	3.7	15.9
270	454365	1/8/2020	A	49	F	2	60	56.01	164.5	22.17	390.0	224.0	383.3	6.7	1.72	6.39	6.84	29.2	17.3	3.8	15.9	100	382.30	7.70	1.97	6.37	6.83	24.6	23.4	3.8	21
271	747210	1/8/2020	B	58	M	2	88	72.57	177.2	28.03	510.0	290.3	236.30	273.7	53.67	2.69	3.26	23.8	12.9	2.4	11.3	100	94.2	415.80	81.53	1.07	1.30	9	12.8	1.0	10.8
272	875158	1/8/2020	B	68	F	2	70	51.92	160	27.34	360.0	207.7	332.50	27.5	7.64	4.75	6.40	17	11.3	3.4	10.4	100	326.4	33.60	9.33	4.66	6.29	12.8	15	3.2	13.5
273	516674	1/8/2020	A	69	F	1	64	51.92	160.00	25.00	360.0	207.7	335.09	24.9	6.92	5.24	6.45	29.5	12.7	3.4	11.4	100	322	38.00	10.56	5.03	6.20	24.9	16.4	3.2	14.5
274	877530	1/9/2020	B	47	M	2	88	68.47	172.7	29.50	480.0	273.9	432.10	47.9	9.98	4.91	6.31	32.5	13.7	4.3	11.7	100	370.3	109.70	22.85	4.21	5.41	31.2	14.9	3.7	12.9
275	878084	1/9/2020	B	45	F	1	65	49.55	157.4	26.24	350.0	198.2	317.30	32.7	9.34	4.88	6.40	23.6	17.4	3.2	15.9	100	300	50.00	14.29	4.62	6.05	19.6	24.5	3.0	23.5
276	820315	1/9/2020	B	52	M	2	65	68.47	172.7	21.79	480.0	273.9	375.70	104.3	21.73	5.78	5.49	17.6	13.7	3.8	12.2	100	368.1	111.90	23.31	5.66	5.38	14.7	16	3.7	14.6
277	874606	1/9/2020	A	47	M	3	65	66.11	170.1	22.46	460.0	264.4	427.80	32.2	7.00	6.58	6.47	30.9	15.3	4.3	12.6	100	359.7	100.30	21.80	5.53	5.44	27.3	15.1	3.6	14
278	878079	1/9/2020	A	60	M	2	62	73.11	177.8	19.61	510.0	292.5	416.60	93.4	18.31	6.72	5.70	17.9	14.8	4.2	13	100	402.6	107.40	21.06	6.49	5.51	12.5	17.1	4.0	15.9
279	878387	1/9/2020	B	32	M	2	85	68.47	172.7	28.50	480.0	273.9	432.10	47.9	9.98	5.08	6.31	27.6	13.5	4.3	12.6	100	428	52.00	10.83	5.04	6.25	23.5	15.9	4.3	14.2
280	877986	1/9/2020	A	55	M	1	98	73.11	177.80	31.00	510.0	292.5	301.60	208.4	40.86	3.08	4.13	18	16.8	3.0	15.9	100	104.4	405.60	79.53	1.07	1.43	11.2	22.2	1.0	20.8
281	872545	1/9/2020	A	81	M	2	86	73.11	177.80	27.20	510.0	292.5	332.50	177.5	34.80	3.87	4.55	24.4	12.5	3.4	11.5	100	295	215.00	42.16	3.43	4.03	20.3	16.6	3.0	14.3
282	875061	1/10/2020	B	45	M	2	45	54.55	157.4	18.16	380.0	218.2	346.50	33.5	8.82	7.70	6.35	27.5	12.6	3.5	11.6	100	329	51.00	13.42	7.31	6.03	23.4	15.6	3.3	14.6
283	426831	1/10/2020	A	53	F	2	85	51.92	160	33.20	360.0	207.7	303.7	56.3	15.64	3.57	5.85	16.3	14.7	3.0	13.5	100	130.60	229.40	63.72	1.54	2.52	8.6	12.4	1.3	11.4
284	876729	1/10/2020	B	62	M	3	90	70.75	175.20	29.32	500.0	283.0	332.50	167.5	33.50	3.69	4.70	32.6	15.6	3.4	14.6	100	329.8	170.20	34.04	3.66	4.66	27.6	17.4	3.0	16.4
285	812369	1/11/2020	B	32	M	2	96	63.83	167.6	34.18	450.0	255.3	332.50	117.5	26.11	3.46	5.21	14.8	15.5	3.3	14.5	100	237.2	212.80	47.29	2.47	3.72	11.8	15.6	2.3	16.4
286	52250	1/11/2020	B	43	F	1	62	61.11	170.1	21.43	430.0	244.4	391.10	38.9	9.05	6.31	6.40	32.8	18.5	3.9	16.6	100	336.5	93.50	21.74	5.43	5.51	30.7	15	3.3	12.4
287	880243	1/14/2020	B	70	M	2	65	68.47	172.7	21.79	480.0	273.9	436.70	43.3	9.02	6.72	6.38	16.7	12.7	4.4	11.7	100	296.1	183.90	38.31	4.56	4.32	13.9	15.3	3.0	14.3
288	880898	1/15/2020	A	43	F	1	76	54.19	162.5	28.78	380.0	216.8	346.90	33.1	8.71	4.56	6.40	23.6	16.2	3.4	14.4	100	298.3	81.70	21.50	3.93	5.50	22.7	11.4	3.0	10.5
289	853278	1/18/2020	B	45	M	2	84	70.75	175.2	27.37	500.0	283.0	405.90	94.1	18.82	4.83	5.74	26.2	12.1	4.1	11.1	100	398.8	101.20	20.24	4.75	5.64	22.7	15.8	4.0	14.4
290	62725	1/20/2020	A	35	M	2	85	68.47	172.7	28.50	480.0	273.9	434.50	45.5	9.48	5.11	6.35	31.4	13.1	4.3	11.7	100	430.2	49.80	10.38	5.06	6.28	26.4	17	4.3	15.8
291	876665	1/23/2020	A	77	M	3	55	66.18	170.18	18.99	460.0	264.7	413.20	46.8	10.17	7.51	6.24	24.6	19.3	4.2	17.5	100	410.5	49.50	10.76	7.46	6.20	19.8	24.6	4.1	22.6
292	846255	1/23/2020	B	72	M	3	70	73.11	177.8	22.14	510.0	292.5	454.40	55.6	10.90	6.49	6.21	17	11.3	4.5	10.4	100	444.4	65.60	12.86	6.35	6.08	12.8	15	4.4	13.5
293	879522	1/23/2020	A	48	M	2	96	68.47	172.7	32.19	480.0	273.9	365.3	114.7	23.90	3.81	5.33	19.1	12.6	3.6	11.6	100	110.20	369.80	77.04	1.15	1.61	10.4	15.4	1.1	14.4
294	885141	1/23/2020	A	54	M	2	70	70.80	175.26	22.79	500.0	283.2	422.20	77.8	15.56	6.03	5.96	29	10.8	4.2	9.8	100	418.2	81.80	16.36	5.97	5.91	28.9	13.6	4.2	11.9
295	886937	1/26/2020	B	49	F	1	62	54.19	162.5	23.48	380.0	216.8	345.90	34.1	8.97	5.58	6.38	31	12.9	3.5	11.5	100	339.4	40.60	10.68	5.47	6.26	26.8	14	3.4	13.5
296	889477	2/1/2020	A	29	F	1	85	49.55	157.4	34.31	350.0	198.2	321.4	28.6	8.17	3.78	6.49	17.9	14.8	3.2	13	100	318.30	31.70	9.06	3.74	6.42	12.5	17.1	3.2	15.9
297	76584	2/1/2020	B	28	F	1	51	51.92	160	19.92	360.0	207.7	326.50	33.5	9.31	6.40	6.29	17.7	14.8	3.3	13.8	100	319.1	40.90	11.36	6.26	6.15	18.7	17.4	3.2	16.4
298	909005	2/3/2020	A	67	F	2	74	54.19	162.5	28.02	380.0	216.8	359.8	20.2	5.32	4.86	6.64	17.9	14.8	3.6	13	100	346.00	34.00	8.95	4.68	6.38	12.5	17.1	3.5	15.9
299	909537	2/3/2020	B	60	M	3	66	61.56	165.1	24.21	430.0	246.2	339.75	90.3	20.99	5.15	5.52	21.6	12.6	3.5	11.6	100	119.8	310.20	72.14	1.82	1.95	12.8	14.8	1.2	13.8
300	890159	2/3/2020	A	41	M	2	84	66.11	170.1	29.03	460.0	264.4	423.00	37.0	8.04	5.04	6.40	29.2	17.3	4.2	15.9	100	413.6	46.40	10.09	4.92	6.26	24.6	22.4	4.1	21
301	892296	2/6/2020	B	24	M	1	90	73.11	177.80	28.47	510.0	292.5	332.50	177.5	34.80	3.69	4.55	23.9	12.9	3.4	11.9	100	324.3	185.70	36.41	3.60	4.44	20	16	3.0	15
302	870068	2/6/2020	A	48	F	1	62	51.93	160.02	24.21	360.0	207.7	332.50	27.5	7.64	5.36	6.40	21.3	17.0	3.4	16	100	323.2	36.80	10.22	5.21	6.22	18.7	19.8	3.2	18.8
303	894075	2/8/2020	B	57	F	3	81	56.56	165.1	29.72	400.0	226.2	366.30	33.7	8.43	4.52	6.48	30.5	14.0	3.7	13.1	100	319	81.00	20.25	3.94	5.64	22	17.3	3.1	16.3
304	893719	2/8/2020	A	80	M	2	89	75.43	180.34	27.37	530.0	301.7	479.90	50.1	9.45	5.39	6.36	31.3	18.0	4.8	17	100	422.5	107.50	20.28	4.75	5.60	25.7	20.3	3.1	19.2
305	895834	2/10/2020	B	54	M	2	58	61.56	165.1	21.28	430.0	246.2	395.70	34.3	7.98	6.82	6.43	21.7	11.5	4.0	10.5	100	396.8	33.20	7.72	6.84	6.45	18.1	14.2	3.1	13.2
306	895667	2/10/2020	A	72	M	1	85	66.11	170.1	29.38	460.0	264.4	340.50	119.5	25.98	4.01	5.15	14.1	13.1	3.4	12.1	100	346.4	113.60	24.70	4.08	5.24	12.8	16.7	3.1	15.7
307	892654	2/11/2020	B	65	M	2	90	63.83	167.6	32.04	450.0	255.3	332.8	117.2	26.04	3.70	5.21	19.8	15	3.1	14	100	98.80	351.20	78.04	1.10	1.55	5.4	9	1.0	7.4
308	895560	2/11/2020	A	59	M	3	81	61.11	170.1	27.99	430.0	244.4	390.40	39.6	9.21	4.82	6.39	28.7	18.7	3.9	17.7	100	327.4	102.60	23.86	4.04	5.36	20.7	23.9	3.1	22.9
309	869648	2/12/2020	B	39	F	2	86	54.19	162.5	32.57	380.0	216.8	347.80	32.2	8.47	4.04	6.42	23.1	12.1	3.5	11.1	100	328.1	51.90	13.66	3.82	6.05	20.9	15.1	3.1	14.1
310	897812	2/12/2020	A	64	F	2	86	49.55	157.4	34.71	350.0	198.2	317.70	32.3	9.23	3.69	6.41	22.6	10.6	3.2	10.5	100	208.2	141.80	40.51	2.42	4.20	17.6	13.1	3.1	12.1
311	897721	2/13/2020	B	56	M	1	68	68.47	172.7	22.80	480.0	273.9	435.50	44.5	9.27	6.40	6.36	31	12.8	4.4	11.8	100	428.6	51.40	10.71	6.30	6.26	27.8	15.6	3.1	14.6
312	706786	2/13/2020	A	52	M	2	76	67.99	172.17	25.64	480.0	272.0	405.00	75.0	15.63	5.33	5.96	28.7	18.7	8.1	17.7	100	380	100.00	20.83	5.00	5.59	20.7	23.9	3.1	22.9
313	588803	2/13/2020	A	58	M	1	76	70.75	175.2	24.76	500.0	283.0	453.80	46.2	9.24	5.97	6.41	30.4	12.8	4.5	11.8	100	402.1	97.90	19.58	5.29	5.68	26.1	17.6	3.1	16.6
314	898456	2/14/2020	A	45	F	2	65	54.55	157.4	26.24	380.0	218.2	350.80	29.2	7.68	5.40	6.43	25.9	14.4	3.5	13.4	100	336.6	43.40	11.42	5.18	6.17	22	17.2	3.1	16.2
315	898049	2/14/2020	B	58	M	2	64	54.55	157.4	25.83	380.0	218.2	346.40	33.6	8.84	5.41	6.35	14.2	16.0	3.5	15	100	345.5	34.50	9.08	5.40	6.33	13.2	19.2	3.1	18.2
316	899961	2/16/2020	B	63	M	2	60	63.83	167.6	21.36	450.0	255.3	347.4	102.6	22.80	5.79	5.44	26.7	15.7	3.1	14.7	100	219.40	230.60	51.24	3.66	3.44	22.2	17.2	2.2	16.2
317	900793	2/18/2020	B	65	F	2	59	54.55	157.4	23.81	380.0	218.2	355.60	24.4	6.42	6.03	6.52	28.3	17.4	3.6	16.4	100	300.5	79.50	20.92	5.09	5.51	23.7	19.7	3.1	18.7
318	888179	2/18/2020	A	60	M	1	98	70.80	175.26	31.90	500.0	283.2	442.60	57.4	11.48	4.52	6.25	22.1	14.1	4.4	13.1	100	431.3	68.70	13.74	4.40	6.09	17.6	19.6	3.1	18.6
319	879481	2/19/2020	B	43	M	1	83	68.47	172.7	27.83	480.0	273.9	442.10	37.9	7.90	5.33	6.46	32	22.0	4.4	21	100	426.6	53.40	11.13	5.14	6.23	24.2	14.2	3.1	13.2
320	896267	2/20/2020	A	40	M	2	89	66.11	170.1	30.76	460.0	264.4	425.90	34.1	7.41	4.79	6.44	24.2	17.3	4.3	16.3	100	358.6	101.40	22.04	4.03	5.42	11.7	20.6	3.1	19.5

Sr. No	Admission No		Failed E-C and rescue with V-E										Predictors of DMV										Operator Characteristics				
		SpO2	Vte	Airleak	Airleak	Vte/AW	Vte/PW	EtCO2	PIP	MV	Plateau	SpO2	Age >51yr	BM1>31	Snoring	OSA	Beard	Edentulous	TM Distance <6cm	MPS 3	MPS4	OTHERS	5-10 Yr	10-15yr	>15Yr	AGE	SEX
257	870178	100	-	-	-	-	-	-	-	-	-	-	N	Y	N	N	N	N	N	N	N	N	Y	-	-	38	F
258	69025	100	-	-	-	-	-	-	-	-	-	-	N	Y	N	N	N	N	N	Y	N	N	-	Y	-	44	F
259	875232	100	-	-	-	-	-	-	-	-	-	-	Y	Y	N	N	N	N	N	N	Y	N	-	Y	-	42	M
260	876657	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	Y	N	N	N	N	N	-	Y	-	44	F
261	439771	100	-	-	-	-	-	-	-	-	-	-	Y	N	Y	N	N	N	N	N	N	N	Y	-	-	38	F
262	387765	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	Y	N	N	N	N	-	-	Y	52	M
263	697989	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	Y	N	N	N	N	N	Y	-	-	39	F
264	699254	100	-	-	-	-	-	-	-	-	-	-	Y	Y	Y	N	N	N	N	N	N	NC >40	-	Y	-	42	M
265	877323	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	N	-	Y	-	44	F
266	877260	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	N	Y	N	-	Y	-	44	F
267	860863	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	N	Y	-	-	38	M
268	877442	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	N	Y	N	-	Y	-	44	F
269	877781	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	Y	N	N	N	N	N	-	Y	-	42	F
270	454365	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	-	-	Y	52	M
271	747210	100	208.5	301.5	59.12	2.37	2.87	20.8	31.4	2.1	10	100	Y	Y	N	Y	Y	N	N	N	N	N	-	Y	-	42	M
272	875158	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	N	-	Y	-	44	M
273	516674	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	N	-	Y	-	42	F
274	877530	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	Y	N	N	N	N	N	-	Y	-	44	F
275	878084	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	-	Y	-	50	F
276	820315	100	-	-	-	-	-	-	-	-	-	-	Y	N	Y	N	N	N	N	N	N	N	-	Y	-	42	M
277	874606	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	Y	N	N	N	Y	N	-	Y	-	42	M
278	878079	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	N	-	-	Y	52	M
279	878387	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	-	-	Y	50	F
280	877986	100	-	-	-	-	-	-	-	-	-	-	Y	Y	N	N	N	N	N	N	Y	N	-	Y	-	44	F
281	872545	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	N	Y	-	-	38	M
282	875061	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	Y	N	N	Y	N	N	-	Y	-	42	M
283	426831	100	-	-	-	-	-	-	-	-	-	-	Y	Y	N	N	N	N	N	N	Y	N	-	Y	-	42	F
284	876729	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	N	-	Y	-	44	F
285	812369	100	321.00	129.0	28.67	3.34	5.03	14.4	15.4	3.3	14.4	100	N	Y	N	N	N	N	N	Y	N	N	Y	-	-	38	M
286	52250	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	Y	-	-	38	F
287	880243	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	Y	N	N	N	Y	N	-	Y	-	42	M
288	880898	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	-	Y	-	44	F
289	853278	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	-	-	Y	50	F
290	62725	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	Y	N	N	Y	N	N	Y	-	-	38	F
291	876665	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	Y	Y	N	N	-	Y	-	44	F
292	846255	100	-	-	-	-	-	-	-	-	-	-	Y	N	Y	N	Y	N	N	N	N	N	-	-	Y	52	M
293	879522	100	-	-	-	-	-	-	-	-	-	-	N	Y	N	N	Y	N	N	Y	N	N	Y	-	-	38	F
294	885141	100	-	-	-	-	-	-	-	-	-	-	Y	N	Y	N	N	N	N	Y	N	N	-	Y	-	43	F
295	886937	100	-	-	-	-	-	-	-	-	-	-	N	N	Y	N	N	N	N	N	Y	N	Y	-	-	38	M
296	889477	100	-	-	-	-	-	-	-	-	-	-	N	Y	N	N	N	N	N	Y	N	N	-	Y	-	42	F
297	76584	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	-	Y	-	44	F
298	909005	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	N	-	Y	-	44	F
299	909537	100	333.30	96.7	22.49	5.05	5.41	27.4	12.8	3.3	11.8	100	Y	N	N	N	Y	Y	N	Y	N	N	-	Y	-	44	F
300	890159	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	Y	N	N	Y	N	N	-	Y	-	42	F
301	892296	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	N	Y	N	Y	-	-	38	M
302	870068	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	-	Y	-	44	F
303	894075	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	N	Y	N	-	Y	-	44	F
304	893719	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	N	Y	N	Y	-	-	34	F
305	895834	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	N	Y	-	-	34	F
306	895667	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	N	Y	-	-	38	F
307	892654	100	327.00	123.0	27.33	3.63	5.12	19.4	14.4	3.3	13.4	100	Y	Y	N	N	N	N	N	N	N	N	-	Y	-	42	F
308	895560	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	Y	N	N	N	N	N	-	Y	-	44	F
309	869648	100	-	-	-	-	-	-	-	-	-	-	N	Y	N	N	N	N	N	N	N	N	-	Y	-	43	F
310	897812	100	-	-	-	-	-	-	-	-	-	-	Y	Y	Y	Y	N	N	N	Y	N	N	-	Y	-	44	F
311	897721	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	N	Y	-	-	38	M
312	706786	100	-	-	-	-	-	-	-	-	-	-	Y	N	Y	N	N	N	N	N	N	N	-	Y	-	42	F
313	588803	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	Y	N	N	Y	N	N	-	Y	-	43	M
314	898456	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	Y	-	-	38	M
315	898049	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	N	-	Y	-	44	F
316	899961	100	333.6	116.4	25.87	5.56	5.23	26.8	15.8	3.5	14.8	100	Y	N	N	N	Y	N	N	Y	N	N	Y	-	-	34	F
317	900793	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	Y	N	Y	N	N	-	-	Y	52	M
318	888179	100	-	-	-	-	-	-	-	-	-	-	Y	Y	N	N	N	N	N	N	N	N	-	Y	-	42	F
319	879481	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	Y	-	-	38	F
320	896267	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	-	Y	-	44	F

Sr. No	Admission No	Date	Treatment Group	Patient's Demographics							Set Tidal Volume (7ml/kg of PBW)	Failure cut-off (4ml/kg of PBW)	V-E										E-C								
				Age	Gender	ASA	Weight	Predicted Body Weight	Height	BMI			Vte	Airleak	Airleak (%)	Vte/AW	Vte/PW	EtCO2	PIP	MV	Plateau	SpO2 (%)	Vte	Airleak	Airleak (%)	Vte/AW	Vte/PW	EtCO2	PIP	MV	Plateau
321	903488	2/25/2020	B	56	M	1	87	56.92	160	33.98	400.0	227.7	367.90	32.1	8.03	4.23	6.46	25	15.0	3.7	13.9	100	133	267.00	66.75	1.53	2.34	8.8	7.8	1.3	6.8
322	872372	2/26/2020	B	45	F	2	85	51.92	160	33.20	360.0	207.7	336.70	23.3	6.47	3.96	6.49	21.8	10.7	3.4	9.7	100	329.8	30.20	8.39	3.88	6.35	19.3	15.3	3.1	14.3
323	902574	2/26/2020	B	70	M	3	85	63.83	167.6	30.26	450.0	255.3	321	129.0	28.67	3.78	5.03	20.4	12	3.1	11	100	126.00	324.00	72.00	1.48	1.97	11.8	7.8	1.3	6.8
324	738	2/27/2020	A	42	F	2	120	63.47	172.7	40.23	440.0	253.9	405.30	34.7	7.89	3.38	6.39	25.1	15.1	4.1	14.1	100	248.7	191.30	43.48	2.07	3.92	16.3	14.9	3.1	13.9
325	896012	2/27/2020	B	44	F	2	82	51.93	160.02	32.02	360.0	207.7	332.50	27.5	7.64	4.05	6.40	21.6	19.6	3.4	18.6	100	324	36.00	10.00	3.95	6.24	19.1	21.1	3.1	20.1
326	908039	3/2/2020	A	35	F	1	65	45.00	152.4	27.99	320.0	180.0	290.20	29.8	9.31	4.46	6.45	24.5	12.4	2.9	11.5	100	244	76.00	23.75	3.75	5.42	14.3	17.3	3.1	16.3
327	906680	3/2/2020	B	70	F	2	61	54.19	162.5	23.10	380.0	216.8	342.00	38.0	10.00	5.61	6.31	29.1	19.0	3.4	18	100	336.9	43.10	11.34	5.52	6.22	23.5	24.5	3.1	23.5
328	908965	3/2/2020	A	28	M	1	75	68.47	172.7	25.15	480.0	273.9	437.40	42.6	8.88	5.83	6.39	27.3	7.3	4.4	6.5	100	422.9	57.10	11.90	5.64	6.18	24.7	13.7	3.1	12.7
329	905913	3/2/2020	A	64	F	3	52	51.92	160	20.31	360.0	207.7	331.70	28.3	7.86	6.38	6.39	15.5	18.5	3.3	17.5	100	327.7	32.30	8.97	6.30	6.31	11	22	3.1	21
330	891456	3/2/2020	B	66	M	2	60	62.38	166	21.77	440.0	249.5	409.70	30.3	6.89	6.83	6.57	31.9	11.9	4.1	10.9	100	396.6	43.40	9.86	6.61	6.36	25.3	15.3	3.1	14.3
331	907852	3/2/2020	A	62	F	2	72	54.19	162.5	27.27	380.0	216.8	353.30	26.7	7.03	4.91	6.52	20.7	19.7	3.5	18.8	100	293.3	86.70	22.82	4.07	5.41	19.4	14.4	3.1	13.4
332	908469	3/2/2020	B	65	F	2	68	51.92	160	26.56	360.0	207.7	335.30	24.7	6.86	4.93	6.46	23.8	14.8	3.4	13.8	100	315.7	44.30	12.31	4.64	6.08	19	20	3.1	19
333	895815	3/2/2020	A	57	M	2	76	73.11	177.8	24.04	510.0	292.5	461.80	48.2	9.45	6.08	6.32	23.2	14.2	4.6	13.2	100	405.1	104.90	20.57	5.33	5.54	17	18	3.1	16.7
334	907890	3/2/2020	A	53	M	2	86	66.02	170	29.76	460.0	264.1	361	99.0	21.52	4.20	5.47	19.7	17.7	3.1	16.7	100	213.00	247.00	53.70	2.48	3.23	13.6	23.6	2.1	22.6
335	905882	3/2/2020	A	60	F	2	75	56.56	165.1	27.51	400.0	226.2	357.90	42.1	10.53	4.77	6.33	23	13.0	3.6	12	100	331.9	68.10	17.03	4.43	5.87	17.5	18.5	3.1	16.5
336	908632	3/3/2020	B	38	M	2	80	66.18	170.18	27.62	460.0	264.7	436.7	23.3	5.07	5.46	6.60	20.3	17.3	3.1	16.3	100	427.60	32.40	7.04	5.35	6.46	14.6	16.6	4.3	15.6
337	785325	3/3/2020	A	89	M	1	65	68.47	172.7	21.79	480.0	273.9	439.70	40.3	8.40	6.76	6.42	15.5	11.5	4.4	10.5	100	327	153.00	31.88	5.03	4.78	10.1	14.1	3.1	13.1
338	909454	3/3/2020	B	50	F	2	88	49.55	157.4	35.52	350.0	198.2	325.10	24.9	7.11	3.69	6.56	14	15.0	3.3	14	100	274	76.00	21.71	3.11	5.53	11.6	20.6	3.1	18.7
339	903639	3/4/2020	A	73	F	2	55	51.92	160	21.48	360.0	207.7	328.70	31.3	8.69	5.98	6.33	18.9	16.9	3.3	15.9	100	319.5	40.50	11.25	5.81	6.15	15.4	24.4	3.1	23.4
340	907720	3/4/2020	B	62	M	1	82	54.55	157.4	33.10	380.0	218.2	348.00	32.0	8.42	4.24	6.38	22	11.0	3.5	10	100	187	193.00	50.79	2.28	3.43	9.4	16.8	1.9	15.8
341	904662	3/4/2020	A	44	M	2	96	56.92	160	37.50	400.0	227.7	313.3	86.7	21.68	3.26	5.50	22.8	12.8	3.1	11.8	100	154.60	245.40	61.35	1.61	2.72	13	10.2	1.5	9.2
342	910308	3/4/2020	B	67	F	2	70	40.38	147.32	32.25	280.0	161.5	256.30	23.7	8.46	3.66	6.35	18.5	14.5	2.6	13.5	100	220.6	59.40	21.21	3.15	5.46	13.7	18.7	3.1	17.7
343	910147	3/4/2020	A	40	M	2	89	77.74	182.88	26.61	540.0	310.9	414.20	125.8	23.30	4.65	5.33	31.8	9.8	4.1	8.8	100	409.9	130.10	24.09	4.61	5.27	26.3	16.3	3.1	15.3
344	888547	3/4/2020	B	45	F	2	88	56.56	165.1	32.28	400.0	226.2	360.60	39.4	9.85	4.10	6.38	24.4	15.4	3.6	14.4	100	300.6	99.40	24.85	3.42	5.31	19.5	18.5	3.1	17.5
345	899789	3/4/2020	B	52	M	2	100	73.11	177.8	31.63	510.0	292.5	405.9	104.1	20.41	4.06	5.55	17.2	11.3	3.1	10.3	100	144.20	365.80	71.73	1.44	1.97	8	12.2	1.4	11.2
346	909713	3/4/2020	B	51	F	2	86	49.55	157.4	34.71	350.0	198.2	317.80	32.2	9.20	3.70	6.41	25.9	16.9	3.2	15.9	100	272.8	77.20	22.06	3.17	5.51	24.2	17.2	3.1	16.2
347	906593	3/4/2020	A	40	M	2	90	75.43	180.34	27.67	530.0	301.7	436.2	93.8	17.70	4.85	5.78	27.2	13.2	3.1	12.2	100	413.50	116.50	21.98	4.59	5.48	22.7	15.7	4.8	14.7
348	909921	3/4/2020	A	53	M	1	84	70.80	175.26	27.35	500.0	283.2	332.50	167.5	33.50	3.96	4.70	24.1	15.1	3.4	14	100	295	205.00	41.00	3.51	4.17	19.3	17.3	3.1	16.4
349	449967	3/4/2020	B	52	M	1	68	75.43	180.34	20.91	530.0	301.7	333.00	197.0	37.17	4.90	4.41	19.8	14.8	3.4	13.8	100	297	233.00	43.96	4.37	3.94	15.3	17.3	3.1	16.3
350	881429	3/5/2020	A	62	F	2	64	51.92	160	25.00	360.0	207.7	333.60	26.4	7.33	5.21	6.43	17.9	13.9	3.3	12.9	100	321.9	38.10	10.58	5.03	6.20	15.1	18.1	3.1	17.1
351	910462	3/5/2020	B	54	M	2	78	56.92	160	30.47	400.0	227.7	368.10	31.9	7.97	4.72	6.47	28.6	12.6	3.7	11.6	100	354.3	45.70	11.43	4.54	6.22	22.2	15.2	3.1	14.2
352	907455	3/5/2020	A	63	M	2	85	68.47	172.7	28.50	480.0	273.9	435.70	44.3	9.23	5.13	6.36	33.4	18.0	4.4	15.4	100	375.4	104.60	21.79	4.42	5.48	28.2	18.1	3.1	17.2
353	908764	3/5/2020	B	55	F	2	63	49.55	157.4	25.43	350.0	198.2	314.10	35.9	10.26	4.99	6.34	25.7	13.7	3.1	11.9	100	271.9	78.10	22.31	4.32	5.49	23.6	16.4	3.1	14.4
354	910254	3/5/2020	B	45	F	1	68	51.92	160	26.56	360.0	207.7	332.70	27.3	7.58	4.89	6.41	28.2	14.3	3.3	12.1	100	323.9	36.10	10.03	4.76	6.24	27.7	18.4	3.1	16.4
355	902731	3/5/2020	A	72	M	1	80	61.56	165.1	29.35	430.0	246.2	397.70	32.3	7.51	4.97	6.46	31.1	15.5	4.0	12.9	100	290.9	139.10	32.35	3.64	4.73	24	17.1	3.1	15.1
356	666424	3/5/2020	B	58	M	1	85	73.11	177.80	26.89	510.0	292.5	432.50	77.5	15.20	5.09	5.92	32.8	17.3	4.3	14	100	295	215.00	42.16	3.47	4.03	22.7	18.1	3.1	16.1
357	902051	3/5/2020	A	19	M	1	94	82.36	187.96	26.61	580.0	329.4	332.50	247.5	42.67	3.54	4.04	27.1	13.8	3.4	11.2	100	294.2	285.80	49.28	3.13	3.57	23.4	15.2	2.9	13.2
358	877806	3/6/2020	A	65	F	2	85	45.00	152.4	36.60	320.0	180.0	288.70	31.3	9.78	3.40	6.42	25.6	11.8	2.9	10.4	100	146	174.00	54.38	1.72	3.24	12.4	15.8	1.4	13.8
359	907225	3/6/2020	A	80	F	2	56	49.55	157.4	22.60	350.0	198.2	319.60	30.4	8.69	5.71	6.45	29	13.5	3.2	11.6	100	184.2	165.80	47.37	3.29	3.72	15	17.2	1.8	15
360	365828	3/6/2020	B	28	M	1	90	75.43	180.34	27.67	530.0	301.7	472.30	57.7	10.89	5.25	6.26	33.3	16.4	4.7	12.7	100	417	113.00	21.32	4.63	5.53	31.2	20.9	3.1	18.9
361	861429	3/7/2020	A	57	M	2	76	77.74	182.88	22.72	540.0	310.9	410.9	129.1	23.91	5.41	5.29	30.3	15.1	3.1	13.1	100	0.00	540.00	100.00	0.00	0.00	0	0	0.0	0
362	907157	3/7/2020	B	68	F	3	90	51.92	160	35.16	360.0	207.7	334.80	25.2	7.00	3.72	6.45	26.7	12.3	3.3	10	100	216.5	143.50	39.86	2.41	4.17	19.6	15.8	3.1	13.8
363	910629	3/7/2020	B	63	F	2	77	54.19	162.5	29.16	380.0	216.8	350.10	29.9	7.87	4.55	6.46	27.2	15.0	3.5	13	100	199.2	180.80	47.58	2.59	3.68	17.4	16.8	2.0	14.8
364	891289	3/7/2020	B	53	F	1	60	49.55	157.4	24.22	350.0	198.2	308.10	41.9	11.97	5.14	6.22	24.4	13.2	3.1	11.1	100	304.9	45.10	12.89	5.08	6.15	23	17.3	3.1	15.3
365	909213	3/7/2020	A	80	M	3	50	68.47	172.7	16.76	480.0	273.9	429.10	50.9	10.60	8.58	6.27	32.6	16.6	4.3	13.6	100	193.8	286.20	59.63	3.88	2.83	17.6	14.8	1.9	12.8
366	912386	3/7/2020	B	42	F	1	58	49.62	157.48	23.39	350.0	198.5	332.50	17.5	5.00	5.73	6.70	27.3	14.3	3.4	12.1	100	324.6	25.40	7.26	5.60	6.54	27.5	17.3	3.1	15.3
367	913597	3/10/2020	B	57	M	1	71	59.19	162.5	26.89	410.0	236.8	377.90	32.1	7.83	5.32	6.38	29.6	17.3	3.8	15.8	100	329.6	80.40	19.61	4.64	5.57	25.4	19.8	3.1	17.8
368	253871	3/10/2020	A	60	M	2	80	68.07	172.26	26.96	480.0	272.3	421.60	58.4	12.17	5.27	6.19	31.9	17.9	4.2	15.5	100	182	298.00	62.08	2.28	2.67	18.4	17.8	2.4	15.8
369	912312	3/11/2020	A	48	F	2	75	58.83	167.6	26.70	410.0	235.3	379.70	30.3	7.39	5.06	6.45	28.9	19.0	3.8	16.3	100	157.4	252.60	61.61	2.10	2.68	17.2	20	1.5	18
370	913998	3/11/2020	A	58	F	2	95	49.55	157.4	38.35	350.0	198.2	299.80	50.2	14.34	3.16	6.05	26.4	12.8	3.0	11.3	100	66.8	283.20	80.91	0.70	1.35	10.4	12	0.6	10
371	909145	3/11/2020	A	60	M	2	88	63.83	167.6	31.33	450.0	255.3	416.80	33.2	7.38	4.74	6.53	31.6	18.5	4.2	15.6	100	175	275.00	61.11	1.99	2.74	18.2	15.2	1.7	13
372	911702	3/11/2020	B	49	M	2	92	63.83	167.6	32.75	450.0	255.3	420.70	29.3	6.51	4.57	6.59	31.6	18.3	4.2	15.6	100	322.7	127.30	28.29	3.51	5.06	25.7	22.3	3.1	20.3
373	874592	3/12/2020	A	57	F	3	92	49.55	157.4	37.13	350.0	198.2	314.50	35.5	10.14	3.42	6.35	26.8	16.5	3.1	15.2	100	178	172.00	49.14	1.93	3.59	18.6	15.4	1.8	13.4
374	905486	3/12/2020	B	55	M	2	113	75.43	180.34	34.75	530.0	301.7	422.9	107.1	20.21	3.74	5.61	31.4	16	3.1	14	100	0.00	530.00	100.00	0.00	0.00	0	0	0.0	0
375	908763	3/12/2020	A	60	F	2	73	54.19	162.5	27.64	380.0	216.8	347.80	32.2	8.47	4.76	6.42	27.6	15.3	3.5	12.4	100	340.2	39.80	10.47	4.66	6.28	25.9	18.8	3.1	16.8
376	914863	3/12/2020	B	50	F	1	48	51.92	160	18.75	360.0	207.7	336.00	24.0	6.67	7.00	6.47	26.2	13.2	3.4	11.3	100	211.1	148.90	41.36	4.40	4.07	20.6	12.6	3.1	11.1
377	914760	3/12/2020	A	55	F	2	68	54.19	162.5	25.75	380.0	216.8	347.40	32.6	8.58	5.11	6.41	28	15.3	3.5	14.4	100	276	104.00	27.37	4.06	5.09	24.4	16.1	3.1	14.6
378	913860	3/12/2020	A	45	F	2	60	51.92	160	23.44	360.0	207.7	332.30	27.7	7.69	5.54	6.40	26.1	14.1	3.3	12.6	100	332.3	27.70	7.69	5.54	6.40	27.3	18.2	3.1	17.3
379	636229	3/12/2020	B	48	F	1	73	54.19	162.5	27.64	380.0	216.8	340.70	39.3	10.34	4.67	6.29	27.1	15.1	3.4	12.8	100	332.1	47.90	12.61	4.55	6.13	26	17.7	3.1	16.4
380	912188	3/12/2020	A	26	M	1	93	68.47	172.7	31.18	480.0	273.9	439.80	40.2	8.38	4.73	6.42	33.1	21.9	4.4	19.4	100	334.9	145.10	30.23	3.60	4.89	26.6	22.8	3.1	21.6
381	857096	3/13/2020	B	82	F	1	50	54.19	162.5	18.93	380.0	216.8	351.20	28.8	7.58	7.02	6.48	28.3	13.4	3.5	11.9	100	195.2	184.80	48.63	3.90	3.60	18	15	1.9	14
382	911051	3/14/2020	A	29	F	1	60	51.92	160	23.44	360.0	207.7	319.60	40.4	11.22	5.33	6.16	25.4	12.5	3.2	10.5	100	319.8	40.20	11.17	5.33	6.16	24.9	14.9	3.1	13.4
383	916136	3/14/2020	B	57	F	1	78	49.55	157.4	31.48	350.0	198.2	322.50	27.5	7.86	4.13	6.51	25.3	20.7	3.2	18	100	273.6	76.40	21.83	3.51	5.52	22.6	21.3	3.1	20.2
384	916727	3/16/2020	A	24	M	3	65	61.56	165.1	23.85	430.0	246.2	394.30	35.7	8.30	6.07	6.41	29.3	15.8	3.9	14.7	100	392.9	37.10	8.63	6.04	6.38	28.6	18.7	3.1	17.7

Sr. No	Admission No		Failed E-C and rescue with V-E										Predictors of DMV										Operator Characteristics				
		SpO2	Vte	Airleak	Airleak	Vte/AW	Vte/PW	EtCO2	PIP	MV	Plateau	SpO2	Age >51yr	BM1>31	Snoring	OSA	Beard	Edentulous	TM Distance <6cm	MPS 3	MPS4	OTHERS	5-10 Yr	10-15yr	>15Yr	AGE	SEX
321	903488	100	314.74	85.3	21.32	3.62	5.53	22	13	3.2	12	100	Y	Y	N	N	N	N	N	Y	N	Y	-	-	34	F
322	872372	100	-	-	-	-	-	-	-	-	-	-	N	Y	N	N	N	N	N	N	N	-	Y	-	43	F
323	902574	100	318.25	131.8	29.28	3.74	4.99	23.6	13.6	3.2	22.6	100	Y	N	Y	N	N	Y	N	Y	N	Y	-	-	34	F
324	738	100	-	-	-	-	-	-	-	-	-	-	N	Y	Y	N	N	N	N	N	N	-	-	Y	53	F
325	896012	100	-	-	-	-	-	-	-	-	-	-	N	Y	N	N	N	N	N	N	N	-	Y	-	44	F
326	908039	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	-	Y	-	42	F
327	906680	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	Y	N	N	N	-	Y	-	44	F
328	908965	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	Y	N	N	N	N	-	Y	-	43	F
329	905913	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	Y	N	N	N	-	Y	-	43	F
330	891456	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	N	Y	-	Y	-	39	F
331	907852	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	N	Y	-	Y	-	42	F
332	908469	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	N	Y	-	Y	-	42	M
333	895815	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	-	Y	-	44	F
334	907890	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	Y	N	Y	N	N	Y	-	-	38	M
335	905882	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	-	-	Y	52	M
336	908632	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	-	-	Y	52	M
337	785325	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	Y	N	Y	N	Y	-	-	34	F
338	909454	100	-	-	-	-	-	-	-	-	-	-	N	Y	N	N	N	N	N	N	N	-	Y	-	42	F
339	903639	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	-	Y	-	44	F
340	907720	100	301	79.0	20.79	3.67	5.52	23.2	11.6	3.0	10.6	100	Y	Y	N	N	Y	N	N	Y	N	N	Y	-	-	34	F
341	904662	100	-	-	-	-	-	-	-	-	-	-	N	Y	N	N	N	N	N	N	N	N	-	Y	-	43	F
342	910308	100	-	-	-	-	-	-	-	-	-	-	Y	Y	N	N	N	N	N	N	Y	N	Y	-	-	34	F
343	910147	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	-	Y	-	34	F
344	888547	100	-	-	-	-	-	-	-	-	-	-	N	Y	N	N	N	Y	N	N	N	N	-	Y	-	44	F
345	899789	100	396.25	113.8	22.30	3.96	5.42	14.8	14	4.0	13	100	Y	Y	N	N	N	N	N	Y	N	N	Y	-	-	34	F
346	909713	100	-	-	-	-	-	-	-	-	-	-	N	Y	N	N	N	N	N	N	N	N	-	Y	-	39	F
347	906593	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	N	Y	N	-	-	Y	52	M
348	909921	100	-	-	-	-	-	-	-	-	-	-	Y	N	Y	N	N	N	N	Y	N	N	-	Y	-	44	F
349	449967	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	N	Y	N	-	Y	-	43	F
350	881429	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	N	-	Y	-	44	F
351	910462	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	N	-	Y	-	44	F
352	907455	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	RE	-	Y	-	44	F
353	908764	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	N	Y	-	-	34	F
354	910254	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	-	Y	-	42	F
355	902731	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	Y	N	N	N	N	N	Y	-	-	34	F
356	666424	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	Y	N	N	N	N	N	Y	-	-	38	F
357	902051	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	-	-	Y	50	F
358	877806	100	-	-	-	-	-	-	-	-	-	-	Y	Y	N	N	N	N	N	N	Y	N	-	Y	-	42	F
359	907225	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	Y	N	N	N	N	-	Y	-	44	F
360	365828	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	-	Y	-	42	M
361	861429	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	Y	Y	N	Y	N	N	Y	-	-	34	F
362	907157	100	-	-	-	-	-	-	-	-	-	-	Y	Y	N	N	N	N	N	Y	N	N	Y	-	-	38	F
363	910629	100	336.5	43.5	11.45	4.37	6.21	25.6	13.8	3.3	11.8	100	Y	N	N	N	N	Y	N	N	N	N	Y	-	-	34	F
364	891289	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	N	-	-	Y	52	M
365	909213	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	Y	Y	N	Y	N	N	-	Y	-	42	F
366	912386	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	N	Y	N	-	Y	-	43	F
367	913597	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	Y	N	N	N	N	N	-	Y	-	44	F
368	253871	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	Y	N	N	N	Y	N	Y	-	-	34	F
369	912312	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	Y	N	Y	N	N	-	-	Y	50	F
370	913998	100	-	-	-	-	-	-	-	-	-	-	Y	Y	N	N	N	N	N	Y	N	N	-	Y	-	43	F
371	909145	100	-	-	-	-	-	-	-	-	-	-	Y	Y	N	N	Y	N	N	N	N	N	-	-	Y	52	M
372	911702	100	-	-	-	-	-	-	-	-	-	-	N	Y	N	N	N	N	N	Y	N	N	Y	-	-	34	F
373	874592	100	-	-	-	-	-	-	-	-	-	-	Y	Y	N	N	N	N	N	Y	N	N	-	-	Y	52	M
374	905486	100	418.25	111.8	21.08	3.70	5.55	31.6	16.6	4.6	14.4	100	Y	Y	N	N	N	N	N	N	Y	N	-	Y	-	42	F
375	908763	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	N	-	Y	-	42	F
376	914863	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	Y	N	Y	N	N	-	Y	-	44	F
377	914760	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	Y	N	N	N	N	-	Y	-	44	F
378	913860	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	MO<2FB	-	Y	-	42	M
379	636229	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	-	Y	-	42	F
380	912188	100	-	-	-	-	-	-	-	-	-	-	N	Y	N	N	N	N	N	Y	N	N	-	Y	-	44	F
381	857096	100	343.80	36.2	9.53	6.88	6.34	27.6	13.2	3.5	11.6	100	Y	N	N	N	N	Y	N	N	Y	N	-	Y	-	43	F
382	911051	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	-	Y	-	44	F
383	916136	100	-	-	-	-	-	-	-	-	-	-	Y	Y	N	N	N	N	N	N	N	N	Y	-	-	34	F
384	916727	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	-	Y	-	42	F

Sr. No	Admission No	Date	Treatment Group	Patient's Demographics							Set Tidal Volume (7ml/kg of PBW)	Failure cut-off (4ml/kg of PBW)	V-E										E-C									
				Age	Gender	ASA	Weight	Predicted Body Weight	Height	BMI			Vte	Airleak	Airleak (%)	Vte/AW	Vte/PW	EtCO2	PIP	MV	Plateau	SpO2 (%)	Vte	Airleak	Airleak (%)	Vte/AW	Vte/PW	EtCO2	PIP	MV	Plateau
385	884875	3/16/2020	B	65	F	3	87	49.55	157.4	35.12	350.0	198.2	322.80	27.2	7.77	3.71	6.51	24.8	19.4	3.2	17	100	161.2	188.80	53.94	1.85	3.25	15.6	17.6	1.6	15.8
386	914926	3/17/2020	B	54	M	2	73	66.11	170.1	25.23	460.0	264.4	428.90	31.1	6.76	5.88	6.49	31.8	18.5	4.3	15.5	100	344.7	115.30	25.07	4.72	5.21	26.5	19.8	3.1	18.7
387	902853	3/19/2020	B	25	F	2	60	49.55	157.4	24.22	350.0	198.2	326.50	23.5	6.71	5.44	6.59	25.6	12.5	3.2	11.5	100	323.2	26.80	7.66	5.39	6.52	24.9	15.3	3.1	14.2
388	918698	3/19/2020	A	80	M	2	70	68.47	172.7	23.47	480.0	273.9	339.8	140.2	29.21	4.85	4.96	27.4	18	3.1	17	100	0.00	480.00	100.00	0.00	0.00	0	7.6	0.0	7.4
389	378822	3/19/2020	B	50	M	2	80	61.56	165.1	29.35	430.0	246.2	385.90	44.1	10.26	4.82	6.27	28.2	15.6	3.9	13.6	100	347.2	82.80	19.26	4.34	5.64	27.5	17.5	3.1	16.3
390	26325	3/19/2020	B	53	M	2	65	73.11	177.8	20.56	510.0	292.5	462.30	47.7	9.35	7.11	6.32	32.9	16.0	4.6	13.9	100	396.3	113.70	22.29	6.10	5.42	29.7	18.7	3.1	17.5
391	916744	3/19/2020	B	64	M	2	105	66.11	170.1	36.29	460.0	264.4	375.1	84.9	18.46	3.57	5.67	27.8	15.3	3.1	14.1	100	0.00	460.00	100.00	0.00	0.00	0	5.8	0.0	5.2
392	918116	3/19/2020	A	23	M	2	60	66.11	170.1	20.74	460.0	264.4	431.20	28.8	6.26	7.19	6.52	33	15.5	4.3	12.7	100	422.7	37.30	8.11	7.05	6.39	31.9	19.3	3.1	18.2
393	917947	3/19/2020	A	56	F	2	65	46.46	154	27.41	330.0	185.8	293.30	36.7	11.12	4.51	6.31	23.9	12.7	2.9	10.9	100	282.4	47.60	14.42	4.34	6.08	22.6	15.5	3.1	14.5
394	846404	3/19/2020	B	63	M	2	87	73.11	177.80	27.52	510.0	292.5	409.40	100.6	19.73	4.71	5.60	30.5	15.4	4.1	13.7	100	295	215.00	42.16	3.39	4.03	23.1	14.2	3.1	13.2
395	918794	3/20/2020	A	30	M	1	70	63.83	167.6	24.92	450.0	255.3	407.60	42.4	9.42	5.82	6.39	31	14.8	4.1	14.3	100	349.5	100.50	22.33	4.99	5.48	26.7	15.8	3.1	14.8
396	454119	3/20/2020	A	45	F	1	78	49.55	157.4	31.48	350.0	198.2	312.80	37.2	10.63	4.01	6.31	23.8	16.9	3.1	14.6	100	266.2	83.80	23.94	3.41	5.37	21.8	19.6	3.1	18.6
397	918969	3/20/2020	B	64	M	3	112	59.19	162.50	42.41	410.0	236.8	408.10	1.9	0.46	3.64	6.89	30.1	18.3	4.1	16	100	116.4	293.60	71.61	1.04	1.97	11.6	15.8	1.1	14.8
398	905801	3/21/2020	A	40	M	2	62	66.11	170.1	21.43	460.0	264.4	431.70	28.3	6.15	6.96	6.53	32.9	16.7	4.3	14.3	100	425.3	34.70	7.54	6.86	6.43	33.1	18.5	3.1	17.6
399	911833	5/7/2020	B	42	F	1	56	49.55	157.4	22.60	350.0	198.2	314.80	35.2	10.06	5.62	6.35	26.1	11.7	3.1	10.5	100	311.8	38.20	10.91	5.57	6.29	23.4	14.4	3.1	13.4
400	910652	10/14/2020	B	58	F	2	67	51.92	160	26.17	360.0	207.7	338.90	21.1	5.86	5.06	6.53	23.3	12.3	3.4	11.3	100	282	78.00	21.67	4.21	5.43	19.1	16.1	2.8	15.1

Sr. No	Admission No		Failed E-C and rescue with V-E										Predictors of DMV										Operator Characteristics				
		SpO2	Vte	Airleak	Airleak	Vte/AW	Vte/PW	EtCO2	PIP	MV	Plateau	SpO2	Age >51yr	BM1>31	Snoring	OSA	Beard	Edentulous	TM Distance <6cm	MPS 3	MPS4	OTHERS	5-10 Yr	10-15yr	>15Yr	AGE	SEX
385	884875	100	318	32.0	9.14	3.66	6.42	25.2	18.4	3.1	17.2	100	Y	Y	Y	N	N	Y	N	Y	N	N	-	Y	-	43	F
386	914926	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	Y	N	N	N	N	N	-	Y	-	43	F
387	902853	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	N	Y	CERVICAL COLLAR	-	Y	-	42	F
388	918698	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	Y	Y	N	N	N	N	Y	-	-	38	M
389	378822	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	-	Y	-	44	F
390	26325	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	Y	N	N	N	N	N	-	-	Y	50	F
391	916744	100	352.40	107.6	23.39	3.36	5.33	26.4	18	3.5	14.6	100	Y	Y	N	N	N	N	N	Y	N	N	-	Y	-	34	F
392	918116	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	-	Y	-	43	F
393	917947	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	N	N	Y	N	N	-	-	Y	52	M
394	846404	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	Y	N	N	N	N	N	-	Y	-	44	F
395	918794	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	-	Y	-	42	M
396	454119	100	-	-	-	-	-	-	-	-	-	-	N	Y	N	N	N	N	N	Y	N	N	-	Y	-	42	M
397	918969	100	396.25	13.8	3.35	3.54	6.69	29	16.6	3.9	15.2	100	Y	Y	N	N	N	Y	N	Y	N	N	Y	-	-	34	F
398	905801	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	-	Y	-	44	F
399	911833	100	-	-	-	-	-	-	-	-	-	-	N	N	N	N	N	N	N	Y	N	N	-	Y	-	42	M
400	910652	100	-	-	-	-	-	-	-	-	-	-	Y	N	N	N	N	Y	N	N	N	N	-	Y	-	43	F

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The Principal,
DMC, Ludhiana.

Subject: Approval of Plan of Thesis.

This is to inform you that the Faculty of Medical Sciences in its meeting held on 29.05.2019 has approved the plan of thesis of **Harsimran Singh**, a student of your college for **MD Anaesthesiology** along with the names of Supervisor/Co-Supervisor as under:-

Topic Plan of Thesis

Comparative evaluation of effectiveness of e-c clamp versus v-e technique in patients with predicted difficult mask ventilation

Supervisor
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The student has to submit the four copies of thesis (along with PDF format) , to the Controller of Examinations, BFUHS, Faridkot, at least six months before the commencement of theory examination, if he/she is otherwise eligible to take the examination. He /She must directed to attach a photocopy of this letter with the forwarding letter while submitting thesis to the University along with the letter of approval of University for change of supervisor/Co-Supervisor, change of topic,(if any).

Dr. S P Singh MS(Oph)
Controller of Examinations

Note :

1. *If any discrepancy found regarding topic of thesis or Supervisor/Co-Supervisor, inform undersigned within one month after issue of this letter.*
2. *The student may submit the thesis as per the schedule already conveyed i.e for May/June examination 30th Nov of the preceding the year of examination and for Nov/Dec examinations 31st May of the year of examination.*

COMPARATIVE EVALUATION OF EFFECTIVENESS OF E-C CLAMP VERSUS V-E TECHNIQUE IN PATIENTS WITH PREDICTED DIFFICULT MASK VENTILATION

THESIS PROPOSAL

FOR APPROVAL OF SUBJECT OF THESIS TO BE SUBMITTED IN

PARTIAL FULFILMENT OF THE REQUIREMENTS

FOR THE DEGREE OF

MD

In

ANAESTHESIOLOGY

OF THE

BABA FARID UNIVERSITY OF HEALTH SCIENCES

FARIDKOT

August, 2018 **DR. Harsimran Singh**

DEPARTMENT OF ANAESTHESIOLOGY
DAYANAND MEDICAL COLLEGE AND HOSPITAL
LUDHIANA

ABSTRACT OF PLAN OF THESIS

Title	COMPARATIVE EVALUATION OF EFFECTIVENESS OF E-C CLAMP VERSUS V-E TECHNIQUE IN PATIENTS WITH PREDICTED DIFFICULT MASK VENTILATION
For the degree of	MD (Anaesthesiology)
Name of the candidate	Dr. Harsimran Singh
Supervisor	Dr. Mirley Rupinder Singh, Professor, Department of Anaesthesia, DMCH, Ludhiana
Co-supervisor(s)	Dr. Anju Grewal, Professor, Department of Anaesthesia, DMCH, Ludhiana
Institution	Dayanand Medical College and Hospital, Ludhiana
University	Baba Farid University of Health Sciences, Faridkot

Introduction: Bag mask ventilation is a skill of utmost importance in maintaining airway for emergency providers as well as anaesthesiologists in operating room. Bag mask ventilation becomes more challenging in cases of difficult airway as failure to oxygenate can lead to cerebral injury and cardiovascular collapse. Thus, developing the skill of effective mask ventilation can minimize the risk of hypoxia, which can be lifesaving in cases of failed intubation.

Aim of Study: The aim of our study is to compare and evaluate the effectiveness of two-handed bag mask ventilation techniques: E-C clamp and V-E technique in patients with predicted difficult mask ventilation.

Material and Methods: A randomized, cross over study will be conducted on 400 adult patients with predicted difficult mask ventilation scheduled for elective and emergency surgical procedures under general anaesthesia. They will be randomized for bag mask ventilation into two groups – Group A -using E-C clamp for bag mask ventilation and group B- using V-E technique for bag mask ventilation after induction of general anaesthesia. The primary outcome for the study will be based on expired tidal volume and also air leak, end tidal CO2 will be recorded in both groups.

Clinical significance: This study will facilitate the effectiveness of E-C clamp over V-E technique or vice-versa in generating adequate tidal volume and minimizing air leak in patients with predicted difficult mask ventilation.

Keywords: Bag mask ventilation, Airway management, difficult airway, expired tidal volume.

(Signature)	(Signature)	(Signature)	(Signature)
Candidate	Co-supervisor	Supervisor	Principal

CERTIFICATE OF FACILITIES AVAILABLE

This is to certify that the facilities for work on the subject of thesis titled **"COMPARATIVE EVALUATION OF EFFECTIVENESS OF E-C CLAMP VERSUS V-E TECHNIQUE IN PATIENTS WITH PREDICTED DIFFICULT MASK VENTILATION"** exist in the Department of Anaesthesiology, DMC&H, Ludhiana and will be provided to the candidate. We will see that the data being included in the thesis is genuine and is collected by the candidate himself under our supervision and guidance.

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APPROVAL PROFORMA
BY
RESEARCH & ETHICAL COMMITTEE
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Department	Anaesthesiology
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Likely date of appearing in PG examination	May 2021
Date of enrollment	May 9, 2018
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Signature of Members of Research Committee with Stamp	**Signature of Members of Ethics Committee with Stamp**
1. HOD Pharmacology	1. HOD Physiology
2. HOD Surgery	2. HOD Pathology
3. HOD Pathology	3. HOD Pharmacology
4. HOD Medicine	4. HOD SPM
5. Dean Academics	5. HOD Medicine
6. Vice Principal	6. HOD Surgery
	7. HOD Obst. & Gynae.
	8. Legal Expert
	9. Secretary, IEC
	10. Dean Academics
	11. Vice Principal
	12. Principal

Approved : Yes / No

Chairperson
Research Committee

Chairperson
Research Committee

Approved : Yes / No

Chairperson
Ethics Committee

Chairperson
Ethics Committee

CERTIFICATE OF DEPARTMENTAL CLEARANCE

This is to certify that the plan of thesis entitled "**COMPARATIVE EVALUATION OF EFFECTIVENESS OF E-C CLAMP VERSUS V-E TECHNIQUE IN PATIENTS WITH PREDICTED DIFFICULT MASK VENTILATION**" has discussed in the Department of Anaesthesiology and approved by whole of the faculty of the department. The plan writing is satisfactory.

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PROFORMA FOR REGISTRATION OF SUBJECT FOR DISSERTATION

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4	DATE OF ADMISSION OF COURSE	09.05.2018
5	TITLE OF THE TOPIC	COMPARATIVE EVALUATION OF EFFECTIVENESS OF E-C CLAMP VERSUS V-E TECHNIQUE IN PATIENTS WITH PREDICTED DIFFICULT MASK VENTILATION

6. BRIEF RESUME OF THE INTENDED WORK

6.1 NEED FOR THE STUDY

Bag mask ventilation is a fundamental and the most basic skill required for management of airway and maintaining adequate ventilation during apneic period at the time of induction of general anaesthesia.[1,2] Patients with predicted difficult mask ventilation are at higher risk of developing hypoxia because of increased air-leak defined as a difference of at least 33% between inspired and expired tidal volumes due to factors such as inappropriate mask size, inadequate mask seal, facial hair, edentulism.[3] Thus, effective mask ventilation can prevent, minimize or reverse hypoxia in cases of predicted difficult mask ventilation and difficult intubation.[4] Predictive factors for difficult mask ventilation includes- age >55 years, male gender, high BMI >26 kg/m^2, bearded, edentulous, neck irradiation, short thyromental distance, restricted neck extension, neck circumference >40 cm and Mallampatti score of 3 and 4.[5-12] Different techniques have been described for holding the face mask during bag mask ventilation to form adequate seal for producing required tidal volume such as the one-handed E-C technique, the two-handed E-C technique and the two-handed V-E technique.[13] To our knowledge, there are very few studies comparing the two-handed E-C technique and the two handed V-E technique.[4,14] One-handed E-C clamp technique is used commonly for bag and mask ventilation, and if ineffective, is shifted to two-handed E-C or V-E technique which provides a better mask-face seal[13,14] which helps in minimizing air-leak and produces greater tidal volume.[15,16] Inadequate mask ventilation (MVi) was defined as an average returned tidal volume of less than 4 ml/kg of predicted body weight (PBW) with clinical signs like inadequate chest rise, no fogging in the mask, no positive tracing of end-tidal carbon dioxide, and/or lack of measurable returned tidal volumes on the anaesthesia monitor.[15] The most commonly used two-handed technique for bag mask ventilation is two

handed E-C clamp in which thumb and index finger of both the hands form C shape over each side of the mask while the third, fourth, and fifth fingers of each hand lifts the lower jaw in a three fingered ‘E’ shape, thus forming better mask-face seal. The two-handed V-E technique uses the thumb and the thenar eminence of each hand placed over each side of the mask while the second to fifth fingers pull the jaw upward, again forming an ‘E’ shape.[17] These two techniques are considered as life saving techniques in predicted difficult mask ventilation and failed intubation. These two techniques require another person or ventilator to deliver positive pressure ventilation.[15,18] In our study we will compare two handed E-C technique with V-E technique in all adult patients scheduled for elective and emergency surgery under general anaesthesia.

6.2 REVIEW OF LITERATURE

Stephane X et al conducted a study to evaluate inadequate seal and air leak during two-hand positive-pressure face mask ventilation in forty-nine edentulous patients. In the presence of air-leak, which was defined as a difference of at least 33% between inspired and expired tidal volumes, the caudal end of the mask was placed above the lower lip while maintaining the head in extension. He concluded that in edentulous patients the placement of face mask in lower lip position with two hands markedly reduced the air leak and improved ventilation.[3]

Fei M et al conducted a study in which he compared the effectiveness of two-handed C-E clamp and modified V-E clamp techniques for mask ventilation. Eighty-one obese adults received mask ventilation in a randomized crossover manner using C-E clamp and modified V-E clamp techniques after induction of general anaesthesia. The primary outcome was expired tidal volume which was significantly lower for the C-E than the V-E technique. It was concluded that mask ventilation using the modified V-E technique is more effective than with the C-E technique in unconscious obese apneic adults.[4]

Hart D et al did a mannequin based prospective randomized study in which comparison of three techniques of face mask ventilation was done on the basis of median exhaled tidal volume and proximal peak flow pressure. Each subject performed face mask ventilation for 3 min per technique (30 breaths) in a randomized order and was found that both two-handed ventilation techniques were more effective than the one-handed technique by both volume and pressure measurements.[13]

Joffe AM et al compared two-handed jaw-thrust technique to the one-handed “EC-clamp” technique for mask ventilation in forty-two elective surgical patients after induction of anesthesia in randomized, crossover fashion. Differences in minute ventilation and tidal volume of both the techniques were assessed and concluded that two-handed jaw-thrust mask technique improves upper airway patency which is measured by

greater tidal volumes during pressure-controlled ventilation than a one handed “EC-clamp technique in the unconscious apneic person.[15]

Soleimanpour M et al conducted a case-control and mannequin based study titled comparison of four techniques on facility of two-hand Bag-valve-mask (BVM) ventilation: E-C, Thenar Eminence, Thenar Eminence (dominant hand)-E-C (non-dominant hand) and Thenar Eminence (non-dominant hand) – E-C (dominant hand) in which 120 volunteers were recruited and divided into two groups. 60 participants in experienced and other 60 as novice group who observed bag mask ventilation but did not have the practical experience about bag mask ventilation. Two experienced examiners who were blind to the ventilation process accessed the quality of mannequin chest expansion. They found that the novice group did Thenar Eminence (non-dominant hand) - E-C (dominant hand) technique much better than the other techniques.[19]

Sato S et al conducted a study on Mask Ventilation during Induction of General Anesthesia in obese patients with sleep-disordered breathing (n = 42) and non–sleep-disordered breathing (n = 38). The efficiency of one mask ventilation was assessed by the number of breaths needed to initially exceed 5 ml/kg ideal body weight of expiratory tidal volume (primary outcome) and tidal volumes (secondary outcomes) during initial 15 breaths. The tidal volume increased progressively in 1 min and did not differ in above mentioned two groups. They found that one-hand mask ventilation is difficult in patients with obesity and severe sleep-disordered breathing while the two-handed mask ventilation produces adequate tidal volume in these patients. [20]

6.3 AIMS AND OBJECTIVES OF THE STUDY

To compare the efficacy of two-handed E-C clamp with two-handed V-E technique of BMV in patients with predicted DMV in terms of –

a) Exhaled tidal volume (Vte)

b) End tidal CO_2 ($EtCO_2$)

c) Peak inspiratory pressure (PIP)

d) Air-leak

e) Minute ventilation (MV)

f) Plateau pressure,

g) Oxygen saturation (SpO_2)

7.0 MATERIAL AND METHODS

7.1 SOURCE OF DATA

A prospective, randomized, cross over study will be conducted in the Department of Anaesthesiology, Dayanand Medical College and Hospital, Ludhiana after approval by Institutional Ethics Committee. A total of 400 adult patients scheduled for elective and emergency surgery under general anaesthesia will be enrolled and randomly allocated into two study groups of 200 patients each. A written informed consent will be obtained from each patient prior to the procedure.

7.2 METHOD OF COLLECTION OF DATA

Inclusion criteria-

All ASA I-III patients, 18 years and older who are scheduled for elective and emergency surgery under general anesthesia with any of the following predictors of DMV:

- Body mass index (BMI)> 31 kg/m^2
- Edentulous
- Snoring
- Obstructive sleep apnea (OSA)
- Bearded
- History of neck radiation
- Short thyromental distance <6cm
- Mallampati score of 3 and 4

Exclusion criteria-

- Untreated Ischaemic heart disease
- Acute and chronic respiratory disorders including chronic obstructive pulmonary disease and asthma
- ASA Physical Status Classification ≥ IV
- Induction requiring rapid sequence for intubation

- Pregnant Women
- Patients requiring an awake intubation
- Ryle's tube insitu

Group Allocation

A total of 400 patients will be randomized into two groups. Randomization will be done by computer generated randomization codes contained in sealed, sequentially numbered envelopes.

Group A: Comprising of 200 patients who will be first ventilated with E-C technique and then will cross-over to V-E technique as per figure 1.

Group B: Comprising of 200 patients who will be first ventilated with V-E technique and then will cross-over to E-C technique as per figure1.

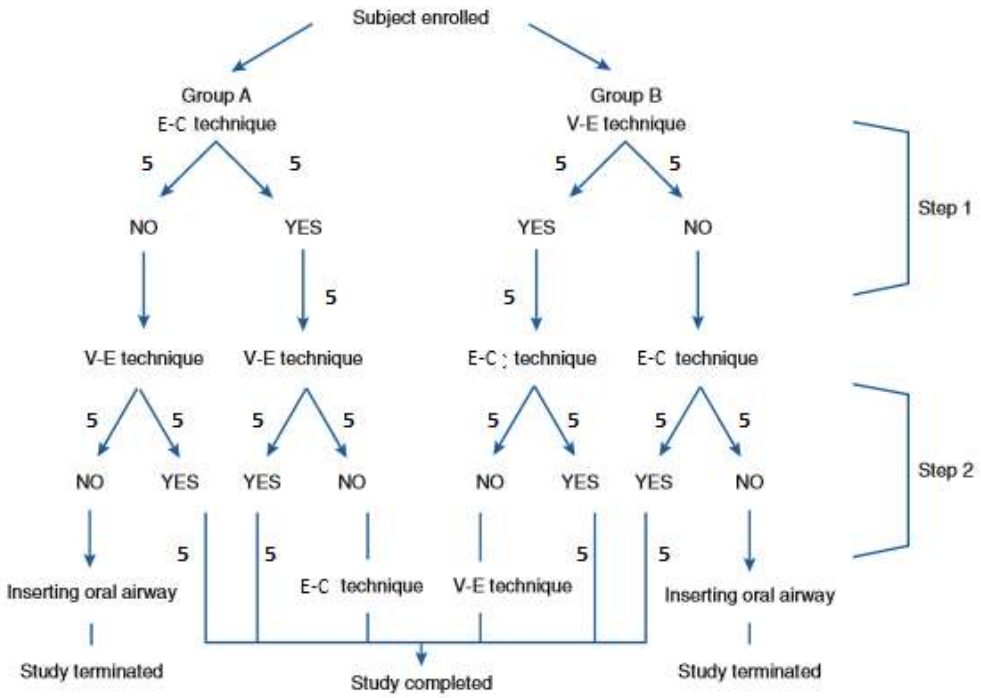

Figure 1: The algorithm of the study design. The numbers listed on the chart represent the number of breaths. At each Step, 10 breaths were targeted.

NO: ineffective mask ventilation as assessed clinically by no visible chest rise, with no exhaled CO_2 measurement or exhaled tidal volume of <4ml/kg in all of the five breaths

YES: effective mask ventilation as assessed clinically by visible bilateral chest rise, exhaled CO_2 measurement and exhaled tidal volume of >4ml/kg in atleast one of the five breaths

Procedure: All adult patients scheduled for elective or emergency surgery under general anaesthesia and fulfilling the inclusion criteria for the study, will undergo pre-anaesthesia checkup. After taking an informed written consent the patient will be shifted to operating room.

In the operating room, standard monitors including ECG, pulse oximeter, non- invasive blood pressure and capnography will be applied. Bag mask ventilation will be performed by trained anaesthesia consultants with experience of more than 5 years. All trained

anaesthesia consultants will be provided with brief instructions before induction with a photograph for each technique (fig. 2). After receiving premedication, pre-oxygenation will be carried out using appropriately sized face mask (size 3, 4, 5 transparent Drager silicone mask) with FiO2 of 1.0 at the flow rate of 10 litres/min of oxygen. Face mask will be chosen to achieve the best fit for patient. Induction of anaesthesia will be commenced with intravenous injection of fentanyl (1-2 µg/kg) and injection propofol (1-2 mg/kg) followed by injection atracurium (0.5 mg/kg). Additional boluses of propofol will be administered by the attending anaesthesiologist based on clinical assessment of continued need for appropriate sedation during the study period. Ventilator will be set to volume control mode providing ventilation at a rate of 10 breaths per minute, tidal volume of 7 ml/kg of predicted body weight and no PEEP (Drager Fabius plus ventilator). When apnoea is observed, patients will be randomized into either group as per random number list. In group A, patients will be first ventilated with E-C technique and if ventilated adequately as defined by bilateral chest rise, exhaled CO_2 measurement and exhaled tidal volume >4ml/kg in atleast one of the first five breaths, then ventilation will be continued for 10 breaths followed by cross-over to 10 breaths with V-E technique. If ventilation fails in all five consecutive breaths with E-C technique, patient will be crossed over to V-E technique. If ventilation with V-E is successful then additional 5 breaths will be delivered with the same technique. However, failure to ventilate with the cross-over V-E technique will lead to termination of the study and ventilation will be continued with adjuncts like insertion of oral or nasal airway. After ventilating for 2.5-3 minutes laryngeal mask airway insertion or endotracheal intubation will be done.

The same protocol will be followed in group B except that V-E technique will be crossed-over to E-C technique.

DATA COLLECTION

In both the groups, following parameters will be assessed and recorded:

a) Exhaled tidal volume (Vte)

b) End tidal CO_2 ($EtCO_2$)

c) Peak inspiratory pressure (PIP)

d) Air-leak

e) Minute ventilation

f) Plateau pressure

g) Oxygen saturation (SpO_2)

The final analysis will be done by calculating the mean of first five breaths in failed ventilation and mean of all ten breaths in successful ventilation. Mean of these values will be used as single data point.

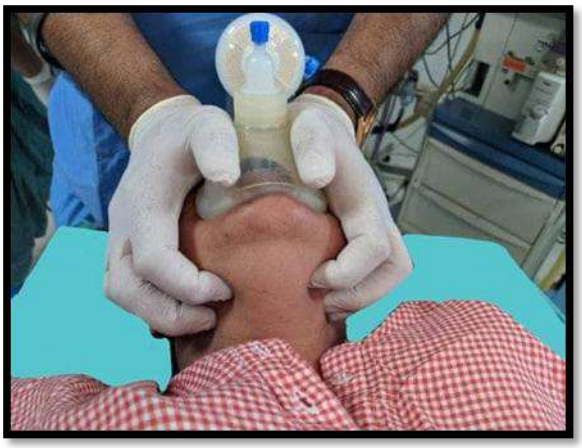

Figure 2.

Two handed E-C clamp in which thumb and index finger of both the hands form C shape over each side of the mask while the third, fourth, and fifth fingers of each hand lifts the lower jaw in a three fingered 'E' shape.

Two handed V-E technique uses the thumb and the thenar eminence of each hand placed over each side of the mask while the second to fifth fingers pull the jaw upward, again forming an 'E' shape.

SAMPLE SIZE:

Based on results of previous study,[4] we have calculated a sample size of 196 patients in each group to detect a 100ml difference in mean exhaled tidal volume (Vte) assuming SD of350 ml and type-1 error of 5% for 80% power of study.

The formula used for sample size calculation is:

$N=16/E^2$

Effect Size (E): (Difference between the means)/SD

According to the above assumption a sample size of 196 patients for each group is calculated. Hence, we will include 200 patients in each group.

OUTCOME:

The primary outcome for analysis in our study will be:

- Exhaled tidal volume (Vte)

The secondary outcomes will include the following:

- Vte /actual body weight, Vte /predicted body weight
- Air-leak (calculated by subtracting exhaled tidal volume from delivered tidal volume. Significant air-leak was defined as difference of atleast 33% between delivered tidal volume and exhaled tidal volume)[3]
- PIP
- Minute ventilation
- Plateau pressure
- $EtCO_2$
- SpO_2

STATISTICAL ANALYSIS: Data obtained will be described in terms of mean ± standard deviation (± SD), frequencies (number of cases) and relative frequencies (percentages) as appropriate. Paired t-test, Wilcoxon-Rank test, Student-t test and Mann-Whitney test will be used for comparing quantitative outcomes, and McNemar's test to compare categorical outcomes with respect to mask ventilation technique. Also, for comparing categorical data, Chi square ($\chi 2$) test will be performed and exact test will be used when the expected frequency is less than 5.

A probability value (p value) less than 0.05 will be considered statistically significant. All statistical calculations will be done using SPSS 21 (Statistical Package for the Social Science) version statistical program for Microsoft Windows.

7.3 DOES THE STUDY REQUIRE ANY INVESTIGATIONS OR INTERVENTIONS TO BE CONDUCTED ON PATIENTS OR OTHER HUMANS OR ANIMALS? IF SO, PLEASE DESCRIBE BRIEF?

The study does not require any investigation or intervention other than those routinely done for every patient for Bag Mask Ventilation.

7.4 HAS ETHICAL CLEARANCE BEEN OBTAINED FROM YOUR INSTITUTION IN CASE OF 7.3?

Yes, attached herewith.

REFERENCES

1. Ortega R, Mehio A, Woo A, Hafez D. Positive-Pressure Ventilation with a Face Mask and a Bag-Valve Device. N Engl J Med. 2007;357(4):e4.
2. Saddawi-Konefka D, Hung S, Kacmarek R, Jiang Y. Optimizing Mask Ventilation: Literature Review and Development of a Conceptual Framework. Respir Care. 2015;60(12):1834-1840.
3. Racine SX, Solis A, Hamou NA, Letoumelin P, Hepner DL, Beloucif S, et al. Face Mask Ventilation in Edentulous Patients. Anesthesiology. 2010;112(5):1190-93.
4. Fei M, Blair JL, Rice MJ, Edwards DA, Liang Y, Pilla MA, et al. Comparison of effectiveness of two commonly used two-handed mask ventilation techniques on unconscious apnoeic obese adults. Br J Anaesth. 2017;118(4):618-624.
5. Law JA, Broemling N, Cooper RM, Drolet P, Duggan LV, Griesdale DE, et al. The difficult airway with recommendations for management–Part 2–The anticipated difficult airway. Can J Anesth. 2013;60(11):1119-1138.
6. Kheterpal S, Han R, Tremper KK, Shanks A, Tait AR, O'Reilly M, et al. Incidence and predictors of difficult and impossible mask ventilation. Anesthesiology.2006;105:885-91.
7. Kheterpal S, Martin L, Shanks AM, Tremper KK. Prediction and outcomes of impossible mask ventilation: a review of 50,000 anesthetics. Anesthesiology.2009;110:891-7.
8. Yildiz TS, Solak M, Toker K. The incidence and risk factors of difficult mask ventilation. J Anesth.2005;19:7-11.
9. Gautam P, Gaul TK, Luthra N. Prediction of difficult mask ventilation. Eur J Anaesthesiol.2005;22:638-40.
10. Kheterpal S, Healy D, Aziz M, Shanks A, Freundlich R, Linton F, et al. Incidence, Predictors, and Outcome of Difficult Mask Ventilation Combined with Difficult Laryngoscopy. Anesthesiology. 2013;119(6):1360-9.

11. Riad W, Vaez M, Raveendran R, Tam A, Quereshy F, Chung F, et al. Neck circumference as a predictor of difficult intubation and difficult mask ventilation in morbidly obese patients. Eur J Anaesthesiol. 2016;33(4):244-9.
12. Cattano D, Killoran P, Cai C, Katsiampoura A, Corso R, Hagberg C. Difficult mask ventilation in general surgical population: observation of risk factors and predictors. F1000Res. 2014;3:204.
13. Hart D, Reardon R, Ward C, Miner J. Face mask ventilation: a comparison of three techniques. J Emerg Med.2013;44:1028-33.
14. Gerstein NS, Carey MC, Braude DA, et al. Efficacy of facemask ventilation techniquesinnoviceproviders. JClinAnesth. 2013;25:193-7.
15. Joffe AM, Hetzel S, Liew EC. A two-handed jaw-thrust technique is superior to the one-handed “EC-clamp” technique for mask ventilation in the apneic unconscious person. Anesthesiology. 2010;113:873-9.
16. Davidovic L, LaCovey D, Pitetti RD. Comparison of 1- versus 2-person bag-valve-mask techniques for manikin ventilation of infants and children. Ann Emerg Med. 2005;46:37-42.
17. Saddawi-Konefka D, Hung SL, Kacmarek RM, Jiang Y. Optimizing mask ventilation: literature review and development of a conceptual frame work. Respir Care. 2015;60:1834-40.
18. Frerk C, Mitchell V, McNarry A, Mendonca C, Bhagrath R, Patel A, et al. Difficult Airway Society 2015 guidelines for management of unanticipated difficult intubation in adults. Br J Anaesth. 2015;115(6):827-48.
19. Soleimanpour M, Rahmani F, Ala A, MortezaBagi H, Mahmoodpoor A, Golzari S, et al. Comparison of four techniques on facility of two-hand Bag-valve-mask (BVM) ventilation: E-C, Thenar Eminence, Thenar Eminence (Dominant hand)-E-C (non-dominant hand) and Thenar Eminence (non-dominant hand) – E-C (dominant hand). J Cardiovasc Thorac Res. 2016;8(4):147-151.

20. Sato S, Hasegawa M, Okuyama M, Okazaki J, Kitamura Y, Sato Y, et al. Mask Ventilation during Induction of General Anesthesia. Anesthesiology. 2017;126(1):28-38.

PROFORMA

Serial No. **Treatment Group:**

Name: **Date of surgery:**

Husband's/Father's Name: **Admission No.**

Age & Sex: **Date of Admission:**

Weight: **Height:** **BMI:**

Predicted Body Weight:

Diagnosis:

Planned Surgery:

Present History:

Past History: **Personal History:**

Diabetes (Y/N) Smoking (Y/N)

Hypertension (Y/N) Alcohol (Y/N)

IHD (Y/N) Drug Abuse (Y/N)

Bronchial Asthma (Y/N)

TB (Y/N)

Renal Disease (Y/N)

Epilepsy (Y/N)

History of previous surgery:

History of Drug Allergy:

Signature of supervisor Signature of candidate

General Physical Examination:

Consciousness level Built & Nutrition

Mouth Opening

Thyromental Distance (cm)

Breath Holding Time (seconds) Spine

Temporomandibular Joint Mobility

Mallampati Score I II III IV

Systemic Examination:

Respiratory System-

Cardiovascular System-

Central Nervous System-

Gastro-intestinal System-

ASA Physical Status: I II III IV V E

Predictors of Difficult Mask Ventilation

	Y	**N**
Age >51 Years (Male)		
BMI >31 Kg/m^2		
Snoring		
OSA		
Beard		
Edentulous		
Neck circumference >40 cm		
Thyromental Distance <6 cm		
MPS 3/4		
Others		

Operator Characteristics:

Signature of supervisor Signature of candidate

- **Age-**
- **Gender-**

  Male

  Female
- **Level of Experience (Years)**

  5-10

  10-15

  > 15

Vitals:

HR BP SpO_2

Set Parameters:

Volume Controlled Mode of Ventilation with:

- Delivered Tidal Volume- 7 ml/kg of PBW
- Respiratory Rate- 10 per minute
- Inspiratory: Expiratory Ratio- 1:2
- PEEP- 0

Signature of supervisor Signature of candidate

Breath	E-C (Vte)	V-E (Vte)	$EtCO_2$	PIP	MV	Plateau	SpO_2
1							
2							
3							
4							
5							

Breath	E-C (Vte)	V-E (Vte)	V-E (Vte)	E-C (Vte)	$EtCO_2$	PIP	MV	Plateau	SpO_2
6									
7									
8									
9									
10									

Breath	V-E (Vte)	V-E (Vte)	E-C (Vte)	E-C (Vte)	$EtCO_2$	PIP	MV	Plateau	SpO_2
11									
12									
13									
14									
15									

Breath	E-C (Vte)	V-E (Vte)	V-E (Vte)	E-C (Vte)	$EtCO_2$	PIP	MV	Plateau	SpO_2
16									
17									
18									
19									
20									

Vte- Exhaled tidal volume, $EtCO_2$- End tidal carbon-dioxide, PIP- Peak inspiratory pressure, MV- Minute ventilation, SpO_2 - Oxygen saturation.

Signature of supervisor Signature of candidate

INFORMED PATIENT CONSENT

Date: _____

I…….D/o, W/o, S/o……am willing to participate in the study **"COMPARATIVE EVALUATION OF EFFECTIVENESS OF E-C CLAMP VERSUS V-E TECHNIQUE IN PATIENTS WITH PREDICTED DIFFICULT MASK VENTILATION"** The procedure with its complications has been explained to me in local vernacular language. I have fully understood that no special tests and extra expenditure in any form, merely for the purpose of thesis is being carried out. I am free to opt out the study any time without assigning any reason.

……. ……

Signature of the Witness Signature of the patient

Name:

Signature of Candidate **Signature of Supervisor**

मरीज अनुमति फार्म

तिथि _____

मैं_____पत्नी/पुत्र/पुत्री _____
निवासी_____
इस शोधकार्य "**COMPARATIVE EVALUATION OF EFFECTIVENESS OF E-C CLAMP VERSUS V-E TECHNIQUE IN PATIENTS WITH PREDICTED DIFFICULT MASK VENTILATION**" में भाग लेने के लिए सहमत हूँ। मैं इस शोधकार्य में भाग लेने के लिए अपनी स्वेच्छा से तैयार हूँ। मैं पुष्टि करता/करती हूँ की यह स्वीकृति देने के लिए मुझे कोई आर्थिक प्रलोभन नहीं दिया गया और न ही दबाव डाला गया है। मुझे इस शोधकार्य का उद्देश्य स्पष्ट कर दिया गया है और मुझे यह विश्वास है की यह विज्ञान और मानवता के लाभ के लिए है। मुझे इस शोधकार्य में होने वाले जोखिम के बारे में समझा दिया गया है और मेरी समझ में यह जोखिम बहुत मामुली है।

मैं इस शोधकार्य में भाग लेने के सम्बन्ध में किसी भी समय अपनी अस्वीकृति व्यक्त कर सकता/सकती हूँ और मेरे अस्वीकृति व्यक्त करने का मेरे इलाज पर कोई प्रभाव नहीं पड़ेगा।

_____ _____

गवाह के हस्ताक्षर रोगी के हस्ताक्षर/अंगूठे का निशान

नाम: नाम:

_____

अन्वेषक के हस्ताक्षर

_____

विद्यार्थी के हस्ताक्षर

ਮਰੀਜ਼ ਰਜ਼ਾਮੰਦੀ ਫਾਰਮ

ਮਿਤੀ_____

ਮੈ_____ਪਤਨੀ/ਪੁੱਤਰ/ਪੁੱਤਰੀ_____

ਵਾਸੀ_____

“COMPARATIVE EVALUATION OF EFFECTIVENESS OF E-C CLAMP VERSUS V-E TECHNIQUE IN PATIENTS WITH PREDICTED DIFFICULT MASK VENTILATION” ਤੇ ਚਲ ਰਹੀ ਖੋਜ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਲਈ ਰਜ਼ਾਮੰਦ ਹਾਂ। ਇਸ ਖੋਜ ਕੰਮ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਲਈ ਮੈ ਆਪਣੀ ਮਰਜ਼ੀ ਨਾਲ ਤਿਆਰ ਹਾਂ। ਮੈ ਇਹ ਦਸਣਾ ਚਾਹੁੰਦਾ ਹਾਂ/ ਚਾਹੁੰਦੀ ਹਾਂ ਕੇ ਇਹ ਰਜ਼ਾਮੰਦੀ ਦੇਣ ਵਾਸਤੇ ਮੈਨੂ ਕਿਸੇ ਵੀ ਤਰਾਂ ਦਾ ਲੋਭ-ਲਾਲਚ ਨਹੀ ਦਿੱਤਾ ਗਿਆ ਅਤੇ ਨਾ ਹੀ ਕੋਈ ਦਬਾ ਪਾਇਆ ਗਿਆ ਹੈ। ਮੈਨੂ ਇਸ ਖੋਜ ਦਾ ਮਨੋਰਥ ਸਮਝਾ ਦਿੱਤਾ ਗਿਆ ਹੈ ਅਤੇ ਮੈਨੂ ਇਹ ਭਰੋਸਾ ਦਵਾਇਆ ਗਿਆ ਹੈ ਕੇ ਇਹ ਖੋਜ ਵਿਗਿਆਨ ਅਤੇ ਮਾਨਵਤਾ ਦੀ ਭਲਾਈ ਲਈ ਹੈ। ਮੈਨੂ ਇਸ ਖੋਜ ਵਿਚ ਹੋਣ ਵਾਲੇ ਖਤਰੇ ਬਾਰੇ ਸਮਝਾ ਦਿੱਤਾ ਗਿਆ ਹੈ ਅਤੇ ਮੈਨੂ ਇਹ ਯਕੀਨ ਹੈ ਕੇ ਇਹ ਖਤਰਾ ਬਹੁਤ ਮਾਮੂਲੀ ਹੈ। ਮੈਨੂ ਇਸ ਖੋਜ ਕੰਮ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਦਾ ਢੰਗ – ਤਰੀਕਾ ਸਮਝਾ ਦਿੱਤਾ ਗਿਆ ਹੈ।

ਮੈ ਇਸ ਖੋਜ ਕੰਮ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਬਾਰੇ ਆਪਣੀ ਰਜ਼ਾਮੰਦੀ ਕਿਸੇ ਵੀ ਸਮੇ ਵਾਪਸ ਲੈ ਸਕਦਾ ਹਾਂ/ ਸਕਦੀ ਹਾਂ ਅਤੇ ਮੇਰੀ ਰਜ਼ਾਮੰਦੀ ਵਾਪਸ ਲੈਣ ਦਾ ਮੇਰੇ ਇਲਾਜ ਤੇ ਕੋਈ ਅਸਰ ਨਹੀ ਹੋਵੇਗਾ।

_____ _____

ਗਵਾਹ ਦੇ ਹਸਤਾਖਰ ਮਰੀਜ਼ ਦੇ ਹਸਤਾਖਰ

ਮਿਤੀ_____ ਮਿਤੀ_____

ਪਤਾ _____ ਪਤਾ _____

_____

ਨਿਰੀਖਕ ਦੇ ਹਸਤਾਖਰ

_____

ਸਿਖਿਆਰਥੀ ਦੇ ਹਸਤਾਖਰ